The WELDING ENGINEER

March
1934
Vol. XIX No. 3

...is a flash from ...ermit mixture, ...that instant a ...n shaft is solidly ...d into one piece.
(See Page 29)

...neer Business and Technical Journal of the Welding Industry

OUR PRESSURE VESSELS STAY IN SERVICE LONGER BECAUSE WE WELD WITH A "SHIELDED ARC"

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THE WELDING ENGINEER

LEADING ARTICLES IN THIS ISSUE

MARCH 1934

Vol. 19, No. 3

NRA MEMBER U.S. WE DO OUR PART

Manganese Steel (Page 15)
Suggestions for Welding Manganese Steel (Eldridge)

Qualification Tests (Page 17)
Qualifying Operators for Government Contract Work

Merchandising (Page 19)
Selling the Services of the Job Welding Shop (Brockson)

Shop Tests (Page 24)
Using Tests to Determine Correct Set-Up and Procedure for Welding (Thom)

Editorial—(Page 13)

Frozen Pipes Thawed Out With Welding Generators—(Page 18)

Views From Boulder Dam—(Page 27)

Get H. O. T. on Welding—(Page 28)

Thermit Repair Releases Street Cars After Tie-Up—(Page 29)

Book Reviews—(Page 30)

New Equipment—(Page 31)

Trade Literature—(Page 32)

Commercial News—(Page 32)

Notes From the Field—(Page 34)

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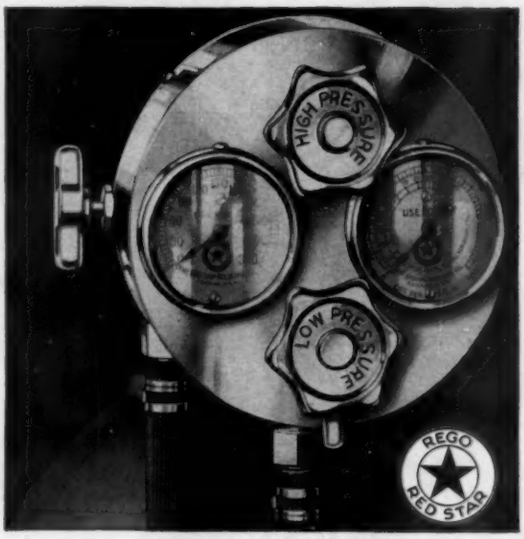

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INDEX TO ADVERTISERS

PAGE

A

Aladdin Rod & Flux Mfg. Co. 36
American Brass Co., The 33
American Manganese Steel Co. 9
American Steel & Wire Co. ..... Rear Cover
Anti-Borax Compound Co. 38
Arcos, Inc. 38

B

Bastian-Blessing Co. 6

C

Central Steel & Wire Co. ..... Inside Rear Cover
Champion Rivet Co. 36
Churchward Engineering Co. 38
Commercial Acetylene Supply Co., Inc. 37

D

Decatur Casting Co. 36

F

Federal Electric Co. 36
Fibre-Metal Products Co. 36

G

General Electric Co. 10, 11
Gulf States Steel Co. 12

H

Harnischfeger Corporation 7
Hobart Bros. 3

I

Ideal Face Shield Co., The 36
Imperial Brass Mfg. Co. 37

L

Lincoln Electric Co., The ..... Inside Front Cover

M

Metal Bond Manufacturing Co. 38
Milburn Co., The Alexander 38

N

National Carbide Sales Corp. ..... Inside Rear Cover

R

Revere Copper & Brass, Inc. 14
Roebling, John A., Sons Co. 4

S

Shawinigan Products Corp. 38
Smith & Sons, Inc., David H. 36
Stoody Co. 37

T

Torchweld Equipment Co. 38

U

Under-Water Metal Cutting Corp. 36
Unimetal Co. 36

· E D I T O R I A L ·

Outlook Is Bright for Extensive Programs of Rail-End Welding

■ Within the past year, two new firms have entered the business of welding rail ends and repairing frogs, crossings and switch points for railroads and street-car systems. Individual manufacturers of tractors are combining their forces with welder manufacturers to develop equipment that will capture a good portion of the orders that it is expected will be forthcoming from railroads for maintenance-of-way equipment. Welder manufacturers themselves are designing equipment to meet the specific needs of maintenance-of-way work. Electrode manufacturers are experimenting with new rods and coatings that will make more reliable deposits on high-carbon rails and will better withstand the impact of moving wheels. All of this forms an interesting picture that is based on the expectation that comfort of passengers and maintenance costs will compel the railroads to make extensive rail-end repairs on main lines and on some branch lines. ¶ During the half century of our nation's history ending about the close of the World War, the steam railroads were hauling an increasing amount of freight, which required fairly frequent replacement of existing rails on many lines with heavier-weight rails, a betterment of the ballast foundation, and, in many cases, a change-over to a double-track system with consequent widening of the ballast foundation and sometimes a relocation of the right-of-way in order better to cope with natural obstacles of the terrain or to eliminate sharp curves which put a limiting speed on traffic. With the passing of this development era, there is no longer the need for the relaying of rails that there once was. The present right-of-ways will withstand the rigors of traffic for many years to come. But some of the heavy high-carbon rails laid 15 or 20 years ago badly need a building up of their battered ends, or the ends should be cropped off and the rails relaid. The latter alternative is a slow, expensive procedure and cannot be carried out where the traffic lane must be kept open. Now our railroad executives, who in the past have been accused (probably unjustly) of being hide-bound and unprogressive, are giving ear to the plaudits of rail-end welding. It looks as though those pioneering adventurers, led by "Doc" Wanamaker, who have been preaching the economy of rail-end welding for lo, these many years, are at last going to get a break. For some years now, they have seen railroads taking hold of rail-end welding in a limited way, but its application on a large scale is probably near at hand, and will be concurrent with such developments as stream-lined and air-conditioned passenger trains, equipped with Diesel power plants, which marks the current year as one of radical departure in railway-equipment design.

Don't Cut Costs at the Expense of the Welding Force

■ One of the gravest abuses that has crept into industry is the piece-work system. When used as a part of an intelligent wage-incentive plan, the piece-work system benefits both employer and employee by making recompense for ability and diligent application to his work and, at the same time, reducing unit costs. Unfortunately, in many plants the piece-work system is no longer a wage-incentive plan but has become a scheme for cutting costs at the sole expense of the laborer, with resulting discontent and haphazard workmanship on the part of the workmen. Those who have spent years in building up a public acceptance of welded products might feel that the results of piece work is not of their concern. If so, their attitude is due for a change when they realize the set-back that this system is apt to give to the promotion of welding. ¶ Ten bridges can be built by welding and every one of them will be a worthy monument to its erector, but let an eleventh one be welded and let it fail, and the critic who exercises little or no sense of discrimination, will make a blanket condemnation of welding. Whether it be bridges, piping, refrigerators, water pans, or whatnot, makes little difference—the attitude created by a failure will be much the same. ¶ The manufacturer located in an area of high living costs, who sets a piece-work rate so low that the welders, applying themselves diligently to the job, can make at the very most 43 cents an hour, had better investigate his product and see whether it's really welding he's getting. When his equipment, put to severe handling and service conditions, begins to come back with open seams, and he starts to determine his costs based on these rejections, he may find that what was intended to be a scheme to reduce costs actually has increased them instead. An unfortunate part is that the harm resulting from such failures is not felt just alone by the person responsible, but it reacts unfavorably on every manufacturer of welded products in that it increases the sales resistance to welded equipment. ¶ If the welding industry wants consumer acceptance of welded products to increase, then this is a time for plain speaking. Users of the welding processes must be made to realize the consequences of their actions; they must not be allowed to reject the high standards set up by those who take their responsibilities seriously, and to substitute in their stead standards of their own on what constitutes good welding. While the situation pointed out is not a critical one, it is apt to become so if there is a further growth in the direction to cut costs at the expense of the welding force, and to curtail efficiency by a piece-work system that harbors the germs of discontent and is apt to be tolerated only by the unfit laborer.

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The Welding Engineer

VOLUME 19 MARCH, 1934 NUMBER 3

Suggestions for Welding Manganese Steel . . .

■ By CHARLES ELDRIDGE

Correct procedure and materials will prevent failure after welding. Application of procedure to street-railway switch points is described.

WELDING of failures and worn surfaces in manganese steel is becoming more and more widely adopted, especially in the railway field, as a method of keeping in service and reclaiming castings that until a few years ago were almost invariably scrapped. But even today the recognition of the potentialities in arc welding of manganese steel lags lamentably behind what the developments in electrodes and welding technique would appear to justify.

Unsuccessful experimentation with unsuitable electrodes and welding procedure and opposition of "old timers" in a position to veto "new fangled ideas" are among the prime causes behind the tardy acceptance, in some quarters, of this efficient method whereby manganese steel can be reclaimed and, in some instances, given a service life several times the life of new sections and at but a fraction of the cost of replacement.

Many railways, both steam and electric, have not given to arc welding of manganese steel the consideration that its importance and possibilities warrant. It is the intention of this article, therefore, to convey some idea of the practical application of arc welding to manganese-steel castings, as applied especially to railway work.

Failures in manganese-steel railway frogs result, usually, from deposits of spongy slag material trapped in the section when cast. As a rule, too, this deposit does not become evident (due to the section being cast with the wearing surface downward, and, consequently, a layer of sound, heavier metal projecting itself between the lighter, spongy deposit and the wearing surface) until, as a result of the weakened condition, the casting cracks, or the insufficiently supported sound metal cups, or yet again, until the sound metal wears off, leaving exposed the slag deposit beneath.

The type of failure mentioned in the foregoing is the most frequently encountered; but it is by no means uncommon to find fractures in the base and walls of a casting and extending sometimes up to and even through the ball. The latter condition depends, of course, on the amount of pounding or stress the frog is subjected to after the fracture developes. Fractures in the base and wall are not the result, as a rule, of a flaw in the casting, but, rather, result from uneven foundation support, pounding of traffic, or both. This costly and sometimes dangerous failure is accentuated by, and is often the direct result of, a second condition—namely, pounding as a result of a worn or cupped surface. If the rail surface is not to be kept appreciably near its original condition, such failures may be looked for; and the wonder, to those that give the matter a little thought, is not that the casting under such conditions should fail, but rather that failure occurs so infrequently.

A stitch in time, so the story goes, saves nine. A bead in time, in welding parlance, saves buying a new crossover.

Welding procedure cannot, of course, be standardized for the reason that the problems to be solved are as varied as they are numerous. It is the intention of the writer, therefore, in this article, to deal in a practical way with a specific type of failure—namely, welding repairs to damaged street-railway switch points. This work has, in the experience of the writer, been done over a period of years with unqualified success, and at about one-sixth of the cost of replacement.

We will now consider a typical failure in street-railway switch points (manganese-steel alloy) as shown in Fig. 1, its preparation for welding as in Fig. 2, and the completed job shown in Fig. 3.

The unsound material (Fig. 1) with resultant crack must be completely removed. This may be done either by grinding or by cutting with a gas torch and grinding away the burned material and any slag deposit which may be left. The section to be filled in will appear somewhat like the cut-out shown in Fig. 2 and must be free from all cracks and spongy metal. If the cutting torch is used, the switch point will bend upward, due, partly, to the mass of metal removed, but mainly to the contraction on the melted surface of the cut-out. This bend can be

REPAIRING OF SWITCH POINTS OF MANGANESE-STEEL ALLOY

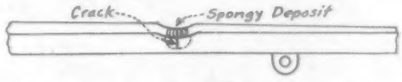


Fig. 1. Typical Failure in Switch Point.

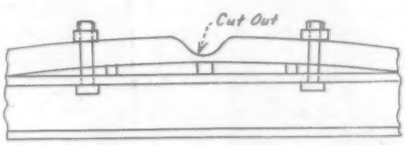


Fig. 2. Illustrating Preparation for Welding.

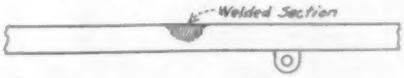


Fig. 3. Completed Repair.

taken out quite readily, however, when the job is clamped down by the method shown in Fig 2.

Before welding, it is necessary to clamp the point down with a considerable bend (Fig. 2) to offset the contraction set up in welding. The amount of bend, however, is not readily calculable and will differ according to amount of metal deposited, peening, etc., but for the average repair job ⅛ in. of bend per foot will suffice. If when the clamps are removed, it is found that the switch point has turned up as a result of the weld contraction, it can be straightened by running a couple of beads on the underside. The beads must be run on at such heat as to sweat into the base metal a depth of 1/8 to 3/16 in., which will cause a displacement of the base metal and will set up counteracting contraction stresses which can be used to pull the point back almost any degree desired and hold it in that position when the deposited metal is ground to a surface finish. If the point has been clamped down at too sharp a bend and does not straighten out sufficiently when the clamps are removed, it can be brought back to the desired camber or straightened by peening and thereby "spreading" the under surface.

In welding manganese-steel switch points, stainless-steel electrodes may be used advantageously up to the last two or three layers. The cohesive properties of stainless-steel electrodes with manganese-steel alloy is equal to that of manganese-steel electrodes. Moreover, stainless steel possesses the advantage that it does not have the same tendency to crack, and consequently leaves a sound, strong deposit. The last two or three layers deposited should be manganese-steel alloy so to obtain a running surface hardness of approximately the same degree as the rest of the switch-point surface.

In filling up the cut-out, run the beads crossways as this makes it unnecessary to butt the walls of the section to be filled in and, as a result, reduces to a minimum the possibilities of incomplete fusion at the ends. The last two or three layers may be run on lengthways if the walls at that point are sloped as in Fig. 2.

Each bead should be peened thoroughly to relieve contraction stresses, and, in the case of the last two layers, to cold-work the metal, thereby increasing its wear-resisting capacity.

Use water for quenching throughout the welding operation. Some electrodes are air-hardening and do not need to be quenched with water, but to prevent a breakdown in the tough properties of the adjacent metal it is necessary that, as far as practicable, the whole mass be kept at a temperature cool enough for the hand to touch. The completed job should be ground to a surface finish.

If the above welding procedure is adhered to, the welded casting will give long and efficient service.

Submits Code for Vessels for Petroleum Fluids

The API-ASME Rules for the Design, Construction, Inspection and Repair of Unfired Pressure Vessels for Petroleum Liquids and Gases were recently submitted to the American Petroleum Institute and The American Society of Mechanical Engineers, the sponsors for the joint committee which prepared this material. This committee was appointed in December, 1931, and has worked intensively during the past two years in developing and revising these rules.

This code consists of five sections, as follows: Design and Construction of Fusion-Welded Vessels; Design and Construction of Riveted Vessels; Design and Construction of Seamless Forged Vessels (this section in course of preparation); Inspection, Repair and Allowable Working Pressure of Vessels in Service; and Material and Other Specifications.

The A.S.M.E. Boiler Code Committee desires comment and criticism on these rules, following which the Boiler Code Committee plans to review them with the idea of adoption in the present or a revised form for incorporation in its Code for Unfired Pressure Vessels.

Several copies of printer's proofs are available for those who are especially interested in this subject and who would like to review the rules and give the joint committee and the Boiler Code Committee the benefit of their suggestions. Copies may be secured, as long as they last, by addressing C. B. LePage, assistant secretary, A.S M.E., 29 West 39th St., New York, N. Y.

Capacity Enrollments for Welding Course

The Milwaukee Vocational School courses in arc and gas welding are running the second semester with near-capacity enrollments in the two classes. The class meeting on Monday and Thursday evenings under the instruction of H. O. Quartz has a registration of 25, and the class meeting on Tuesdays and Fridays under G. L. Henes also has about the same enrollment. While the demand for both oxyacetylene and arc-welding instruction continues high, the arc-welding course has become so popular that two new arc-welding units, a P&H Hansen and a Wilson, were recently added to the school equipment, making a total of four arc-welding units available. Among those enrolled are many young men who have chosen welding as the trade in which they wish to specialize, and then there are plumbers, steamfitters and ironworkers who are taking the courses because they can see welding taking a fast hold in their respective fields.

St. Paul Has 4-Day Welding Confab

A "Welding Confab" is being held in St. Paul, Minn., in the General Motor Truck Building at Raymond and University Ave., on March 14th to 17th, under the sponsorship of the Commercial Gas Co., of Minneapolis. Admission is free to all who are interested in welding. This "confab" will consist of exhibits and demonstrations of welding and allied processes. These will include bronze welding, flame cutting, the welding of cast iron, steel and white metal with the oxyacetylene flame, electric welding of cast iron, welding with the shielded arc and the carbon arc, welding of aluminum, stainless steel, monel metal, brass and copper, plow welding, hard facing, and metal spraying.

Simultaneously with the demonstrations, educational motion pictures will be shown and discussions conducted under the direction of Stuart Plumley, of the Smith Welding Equipment Co.

Explains Use of Polarized Light in Analyzing Stresses

The use of polarized light in studying strains and stresses in welded joints will be the topic of the meeting of the St. Louis Welding Society to be held on March 23rd, at 8 p m., at which E. W. P. Smith, of The Lincoln Electric Co., Cleveland, Ohio, will be the speaker. The meeting will be held at the Gallaudet School, 1604 S. Grand Blvd.

Mr. Smith will show how strains and stresses in welded joints can be eliminated to a considerable extent by proper design and welding procedure, without the necessity of normalizing. He will use lantern slides and samples to illustrate the points of his talk and to explain the theory of using polarized light to show stress concentrations in models made of bakelite or celluloid, thereby indicating the effect of weld contour on the extent and location of stresses.

Visits American Plants to Study Structural Welding

Having been awarded a Robert Blair Fellowship by the London (England) County Council for study in applied science and technology abroad, D. Bruce Johnston is spending a year in the United States studying American methods of electric welding, more especially in its application to structural steelwork. Since his graduation from London University four years ago, Mr. Johnston has been employed on various engineering projects in England. During his visit in this country, he is investigating the application of arc welding to buildings and to the strengthening and repairing of bridges, as well as to the building up of machine parts such as bases.

Qualifying Operators for Government Contract Work

SOME of the contracts issued by the Federal Government requiring welding carry a clause to the effect that all welding must be done by welders certified in accordance with the tests of the American Bureau of Welding. For the benefit of fabricators and contractors, the tests referred to are reprinted herewith, being taken verbatim from Section B, page 11, of the Appendix of the Code for Fusion Welding and Gas Cutting in Building Construction, Part A, edition of 1930, published by the American Welding Society, which is a transcript of the qualifying tests used by the Structural Steel Welding Committee of the Bureau of Welding given on pages 25 to 27 of the committee's report dated September, 1931.

It will be noted that five test plates must be welded, from each of which four coupons are to be cut, making a total of 20 test coupons for each welder who is to be certified. Only tests for tensile strength are specified, and the coupons are all butt welded and welded from one side only.

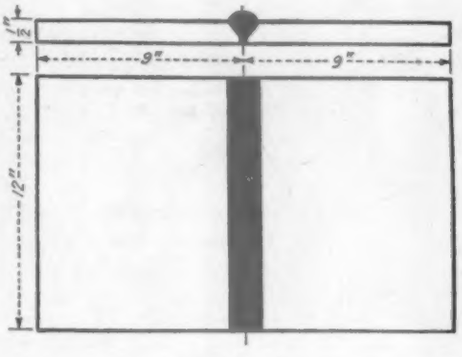
QUALIFYING TEST FOR WELDING OPERATORS

This test requires the welding of five test plates similar to Fig. 1. Three of these plates shall be welded in a flat position, that is, the specimen is to be laid flat on a welding table or other suitable support. Two of these plates shall be welded in a vertical position, that is, the longitudinal axis of the joint is to be upright during welding.

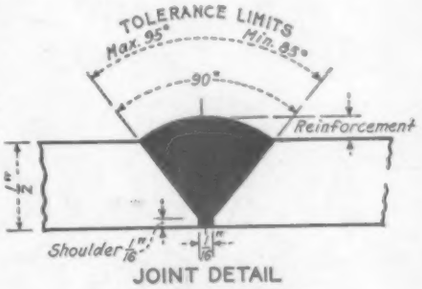
The material for these test plates shall be open-hearth structural steel for buildings conforming to the latest A. S. T. M. specification A-9.

From each test plate, four standard American Welding Society test coupons shall be cut as shown in Fig. 2. The plain coupons, 18 in. long by 2 in. wide, shall be removed from the test plate by sawing or by cutting with a gas cutting torch. The coupons shall then be machined to the dimensions shown in Fig. 2, and any reinforcement of the weld above the base metal shall be removed by machining or grinding so that the thickness of the coupons at the weld shall not exceed the thickness of the base metal.

The average tensile strength per square inch of all the coupons shall not be less than 45,000 lb. if arc welded, or 52,000 lb. if gas welded, and the tensile strength per square inch of any one coupon shall not be less than 40,000 lb. if arc welded or 50,000 lb. if gas welded.



JOINT DETAIL
FOR ARC WELDING



JOINT DETAIL
FOR GAS WELDING

Fig. 1. Details of Welded Test Plates.

SPECIFICATIONS

Single-V butt joint welded one side only.
Weld penetration, 100%
Reinforcement, 20% of plate thickness.

FOR ARC WELDING

Number of weld layers, 2.
Amperes, average—
In flat position, 200.
In vertical position, 175.
Size of electrode, $\frac{1}{8}$ in.

Note — Before being welded, the plates shall be tack welded at the ends of the joint.

FOR GAS WELDING

Method of welding, forward or backward.
Speed for ½-in. metal—
Flat welding, not less than 2 ft. per hour.
Vertical welding, not less than 1½ ft. per hour.
Width of finished weld, not less than 2½ times plate thickness.

Note—Plates shall be clamped to a suitable table. The edges of the $\frac{1}{8}$-in. shoulder at the end of the joint remote from that where the welding is started shall be spaced from $\frac{1}{16}$ in. to $\frac{1}{8}$ in. farther apart than is shown in the figure in order to compensate for contraction during welding.

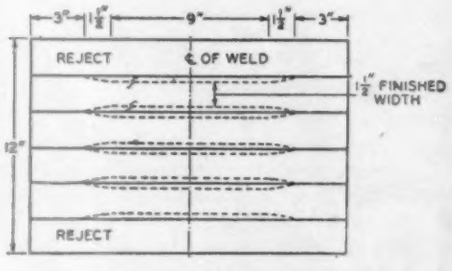


Fig. 2. Each Test Plate Is Cut as Shown, Producing Four Welded Tensile-Test Specimens.

Frozen Pipes Thawed Out With Welding Generators

The unusual severity of the past winter with its record snows and ice and sub-zero temperatures in many sections of the country, has placed the electrical thawing of frozen pipes in the limelight, according to General Electric engineers. Arc-welding generators have been particularly useful for this service.

Although the practice of heating frozen pipes by passing an electric current through them is not new, it has taken a season when frozen water lines formed the rule and not the exception to bring the advantages of this thawing method into prominence. Such advantages are particularly apparent when the frozen pipes are underground or otherwise inaccessible.

Arc-welding generators, because of their special electrical characteristics, are extremely well suited to the work. High currents are required at relatively low voltage, and load resistance (resistance of the length of pipe in the circuit) varies widely from job to job.

The process itself is simple: The leads from the generator are connected to the pipe or piping system so as to include the frozen section in the electric circuit. The heavy current warms the pipe and shortly melts the ice. The current required and the time necessary to effect thawing depend on the size and length of the pipe. For instance, it has been the experience of some users that 250 amperes will thaw a ¾-in. pipe 300 ft. long in from 3 to 10 minutes—and again that a 3-in. pipe 100 ft. long will take nearly an hour with the current in the neighborhood of 500 amperes. Voltages involved vary widely, usually between 10 and 50 volts being required. It is therefore readily understood why a welding generator, whose output voltage can be varied over a considerable range for several different current values, is so well adapted to thawing.

To obtain portability and mobility, a welding generator for pipe thawing is ordinarily mounted on a motor-truck. A gas engine is the normal driving unit and the two machines can be either belted together or direct coupled.

Many welding companies owning truck-mounted welding generators have been able to render valuable emergency pipe-thawing service.

Flanged Piping Converted to All-Welded System

The changing over of a flanged and bolted piping system, most of which carries high-pressure steam, to an all-welded system, constitutes part of the rehabilitation program of the Container Corporation of America, manufacturers of paper products, for their plant at 403 E. North Water St., Chicago, Ill. All flanges in the old pipe will be cut out and replaced with nipples welded to the pipe. Collars and saddles will also be replaced with welded joints. The pipe varies in diameter from 1½ to 14 in. Oxyacetylene welding will be used, with Norway iron filler rods. The company has set aside $400,000 in this year's budget for making plant changes, compared with $200,000 appropriated last year.

Large Stainless-Steel Order for Liquor Plant

Twenty-two tanks with a total capacity of 13,800 gallons are included in the equipment of the new liquor blending and rectifying plant of George Benz Sons, Inc., at St. Paul, Minn. All of these tanks, together with other equipment and utensils, are of Enduro stainless steel, a product of Republic Steel Corporation, Central Alloy Division, Massillon, Ohio, and are entirely welded. Nearly 12,000 lb. of Enduro steel sheet was required for the order. The equipment was fabricated by Farwell, Ozmun, Kirk & Co., St. Paul. Engineers were Reliance Engineers, Inc., also of St. Paul.

The installation includes the following Enduro equipment: six 300-gal. bottling tanks, three 500-gal. blending and storage tanks, six 1000-gal. blending and storage tanks, two 500-gal. storage tanks, three 500-gal. dump tanks, 2 1000-gal. dump tanks, funnels in various sizes up to 3 gal., dump pans, drip pans, whiskey dumps, 25 measures in sizes from ⅛ to 5 gal., and a bottling table.

Boulder Dam Is Topic at New York Meeting

A meeting devoted to the engineering aspects of the Boulder Dam project, with particular reference to the fabrication of the huge penstocks, was held in New York on March 13th in the auditorium of the Engineering Societies Building, 29 West 39th St., under the auspices of the New York Section of the American Welding Society and the Metropolitan Sections of the American Society of Mechanical Engineers and the American Society of Civil Engineers.

The program, as announced, consisted of a lecture on "Special Features of the Boulder Dam Project, Including Penstocks," by Dr. J. C. Hodge, chief metallurgist of The Babcock & Wilcox Co., and a talk on "Stresses and Strains Involved in the Boulder Dam Penstocks," by S. C. Hollister, of Purdue University, Lafayette, Ind. Official U. S. Government motion pictures showing the general layout and the vast works of construction were shown. The meeting was presided over by Dr. Elwood Mead, commissioner of reclamation, Department of the Interior, Washington, D. C.

Pacific Coast Sections to Cooperate on Programs

At a meeting of the Executive Committtee of the Los Angeles Section, held on Feb. 2nd, J. C. Blake was appointed chairman of the Program Committee and Frank Howard chairman of the Committee on Membership. The Los Angeles Section purposes to cooperate with the San Francisco section on programs.

"Interesting Applications of Hard-Facing" was the subject of a talk by W. F. Stoody, president of the Stoody Co., Whittier, Calif., given at the meeting of the Los Angeles Section of the American Welding Society on March 15th.

Though inclement weather cut down the attendance at the Feb. 15th meeting of the Los Angeles Section, those present were well repaid for braving the storm by listening to two excellent talks on welding costs.

"Modern Accounting for Modern Welding Shops," by Wm. T. Wheeling, accountant for the National Electric Welding Corp., of Huntington Park, was an authoritative talk on job shop welding costs, going into detail on the many items of costs and overhead, including portable welding unit operation costs, depreciation, etc. The second talk was by C. E. Burt, in charge of engineering and manufacturing for the Baker Oil Tools, Huntington Park, whose subject was "Welding Costs and Overhead in Oil Field Equipment Shops." Mr. Burt stated that the Code Committee for the Oil Equipment Division of the NRA found the most practical method for charging customers for welding shop work was $2.50 per hour, plus materials.

Sub-Zero Weather Ushers in Ohio Conference

The attendance at the third annual welding conference held by The Ohio State University at Columbus on Feb. 28th and March 1st was considerably below that of previous conferences owing to serious competition from Old Man Weather, who served up a dish of weather for the first day of the conference fit only for Eskimos, with high snowdrifts and a temperature of 12 below zero. The exhibitors were: Air Reduction Sales Co., American Optical Co., The Bastian-Blessing Co., Crane Co., The Electric Controller & Mfg. Co., Gas Products Co., General Electric Co., Handy & Harman, Harnischfeger Corp., The Harris Calorific Co., Hobart Bros. Co., The Imperial Brass Mfg. Co., The Industrial Commission of Ohio (Division of Safety and Hygiene), The Lincoln Electric Co., Linde Air Products Co., Republic Steel Corp., Safety Gas Lighter Co., Sellstrom Mfg. Co., Sight Feed Generator Co., and *The Welding Engineer*.

Selling the Services of the Job Welding Shop

By W. I. BROCKSON
Steel Sales Corp.

THE business problems of most welding contractors may be classified under three principal headings, namely: financial, manufacturing, and selling. Of these, only selling comes within the range of this discussion. As regards the manufacturing end of the business, however, it has been my observation that in over 90% of the job welding shops of the country the knowledge and skill in the art and technique of welding are developed to a far higher degree than proficiency in the all-important operation of selling the services which the shop can render. In fact, if we were to compare the practical welding ability exhibited in the average shop with the ability to go out and get new customers, it would be almost like making a comparison between an ocean liner and a row boat. Frankly, the average job-shop owner is not sales-minded.

What I have to say about the selling end of the welding contracting business is the result of information obtained by personal calls upon contractors and shop owners made by myself and 35 of our company's salesmen in the Middle West, by our welding engineer who spends most of his time making demonstrations in industrial plants and shops, as well as by correspondence with some of the successful shops in the East and South. I come to you as an outsider, so to speak, but an outsider frequently can see points of strength and of weakness in an industry which are not apparent to one who has his nose close to the "daily grind."

Good Sales Management Is Necessary to Success

If I were called upon to name the greatest need of the job-welding industry today, my answer would be not a greater development of the art and the science of welding; it would not even be the elimination of the price-cutter and chiseler. But it would be a broader understanding and a more consistent practice of the sales and sales promotion operations required to bring in a larger and more profitable volume of business. More briefly stated, there is a crying need for the job welder to be a better sales manager.

In discussing the subject of this paper with shops having all degrees of sales ability, from the lowest to the highest, we came in contact with three large and very successful establishments whose owners claimed they had never done any selling or advertising, and whose success at first blush tended to prove that none was necessary. In analyzing the experiences of these men, however, it was found that their success had been built upon very sound fundamentals.

In every case, prior to establishing their own business, the managers of these shops had had broad and thorough experience and training in all the principal classifications of welding. In one instance, the manager had been for ten years with one of the nation's largest manufacturers of welding machines and had occupied the positions of traveling salesman, demonstrator and instructor of welders. In another instance, the owner had been for five years with a national organization distributing gases and gas-welding equipment, and for another five years with a prominent manufacturer of electric welding machines.

THIS paper received such widespread, favorable comment when read at the Purdue University and the Iowa State College Welding Conferences that we are pleased to print it here, with permission of its author.—Editor.

When these men started in business for themselves, they were master welders, and turned out every job according to the best practices known to the industry. They were conscientious and painstaking. Naturally, they began in a small way, but each and every job turned out gave excellent satisfaction. The first customers became repeat customers, and they passed on their satisfaction by word of mouth to other prospects for job welding services.

One of these men expressed the opinion that a welder should be as much a professional man as a doctor. His work should speak for itself. He felt that the only advertising or selling efforts that a job shop should put forth should consist of doing the very best possible jobs of welding.

Most assuredly we have no quarrel with the philosophy that every job of welding should be well done, nor with the philosophy that satisfied customers are the best advertisement. We consider these two fundamentals absolutely essential for the success of any shop. However, we would consider it a dangerous program for all job welders to stop with doing a good technical piece of work and to do nothing to merchandise their ability and experience to new prospects.

We are forced to this conclusion from many points of view. In the first place, we have found that most of the small one-man shops whose managers are barely able to make a living do a fair job of welding, but they do absolutely nothing in the way of selling or advertising. On the other hand, by far the majority of the larger and more successful shops have a definite plan of selling and sales promotion. Furthermore, our general business experience leads us to the conclusion that the day is gone when the world will beat a pathway to the door of the man who makes a better mousetrap. Not only must his mousetrap be better, but he must continually explain the advantages of his trap to people who are troubled with mice.

Man-to-Man Contact Builds Business

Perhaps the most effective means which job welding shops can use to build business is personal selling—man-to-man contact—made by the representative of the welding establishment calling on his prospect and talking with him personally. Practically every shop we interviewed agreed that personal salesmanship is the best tool for the weldery to use in expanding its business.

If a job shop intends to carry on a successful personal selling campaign, it should observe a few fundamental principles—principles which we find being followed in the most progressive shops and being ignored in the poorer ones:

1. The owner or manager must realize the importance of organizing to do the selling job and must have the "go getter" habit of thinking as opposed to being content to sit around and wait for work to come in.

2. There should follow a scheduling of the time of all the people in the shop so that definite arrangements are made for one or more of them to spend all or a definite part of their time outside the shop in personal contact with the trade. In so many shops the matter of personal selling is the last activity that is thought of. Everybody has a multiplicity of duties and if any duty has to be slighted it is selling. As a result, the business goes along in a rut from year to year without expansion. In all but three of the top-notch shops we encountered, nothing

was allowed to interfere with the personal-selling schedule—as averaged up over a period of months. And thus it should be.

3. Next, organize your calling list before starting on any personal-selling program. If you happen to be one of the hundreds of shops that have never carried on a consistent personal-selling campaign, one of the very first things to do is to go back over the list of firms and individuals that you have done work

The Shop Owner Who Sits Down and Waits for Business Can Take a Long Nap Without Being Disturbed.

for in the past. If you have been in business three years or longer, you will be surprised to find the great number of companies that have not given you any business for many months or even years. A good share of these are still having welding done. But you have, perhaps for lack of making the proper contacts with them, allowed the business to slip away from you. Other names on your books will represent firms out of business. Others will have obsolete addresses. The very first thing to do is to check this list with your personal knowledge, with telephone directories, with Dun & Bradstreet's and other authoritative sources, to see that the list is as nearly correct and up-to-date as possible.

Keep a Card Record of Customers and Prospects

4. A simple, workable customer and prospect record should be established to be used in connection with sales activities only. It should be entirely separate from ledger records of cash sales and accounts receivable. It does not need to be elaborate; 3x5-in. cards or 4x6-in. notebooks will serve the purpose nicely. A few of the essentials are that only one name and address be kept on a card or a sheet, that there be room for brief records, that every name in the field be accessible on a moment's notice, and that the filing system be such that it is easy to file and fit new names into it. An elaborate filing system requiring much time to keep up-to-date is decidedly out of place in a welding contractor's place of business, but a simple, practical set of customer and prospect records is absolutely essential for the proper guidance of personal-sales activities.

5. After the customer records have been checked and placed on the sales record system, the next step is to study the list carefully as to the lines of business represented, as to location of the plants and other factors which may suggest likely lines of business or individual firms that have never been solicited but which are good prospects. It may develop, for example, that the majority of old customers are garages. If this be true, it will suggest that perhaps your most likely field of new prospects to cultivate will be the garages you have not sold. Or it may be that farmers have given you more business than any other one group. If so, give serious thought to how business may be obtained from other farmers. Or it may develop that a certain type of welding, such as boiler repair or the building-up of valve seats in gasoline engines, has been the source of your greatest income; this condition would suggest two avenues of thought: first, who are the prospects for this kind of welding in the territory not being sold, and second, is this type of work being specialized in at the expense of other profitable fields?

A careful analysis of the old customer records along the lines just suggested should point out the names of scores of new prospects—firms that either are using welding service or can be sold on it but which are not on your books. After the best of such names have been compiled and checked for accuracy, they should be added to the sales record file already described.

6. With the record of customers and prospects compiled, it is now time for the salesman, be he boss or hired man, to start out to call on the trade.

The whole field of successful and unsuccessful practices included in the contact of salesman with prospect is too broad to be covered here, but there is one point worthy of mention because it is something badly needed by most job shops and because it fits in with the management of the sales record file we have been discussing.

Work Out a System for Making Calls

After the salesman makes his round once or twice, he naturally will find some prospects worthy of frequent calls, and others that should receive less frequent calls. Now, one of the greatest weaknesses of all personal selling is the hit-or-miss fashion with which good prospects are given attention in many organizations. It frequently happens that a firm which should be visited once a month is skipped for six months or longer. Good opportunities to develop worthy accounts are lost, simply because the proper amount of intelligent persistency is not used.

A simple but effective plan can be worked into the record system to eliminate this to a large extent. Plans like this one are being used by a large number of successful salesmen. On the card used to record the name and address of the firm, provide a few ruled spaces, one for each month of the year. After one or two calls, an intelligent estimate can be made of the number of times a year each account should be contacted—once a month or once in two months. This figure should be noted on the card. At the end of his day's work, the salesman turns to each of the cards representing firms he has called on that day, and simply makes a check mark in the space for the current month. If it happens that he makes two calls on the same firm in any one month, there naturally will be two check marks in the space for that month. This is a very simple operation and can be done in five minutes.

At the end of the month the cards can be looked through, and those having no check marks for the month will "show up like a house afire." If the record shows that some of the good ones which should receive regular attention have been skipped, they should be contacted immediately.

Going back to the question of tactics of the salesman while in the presence of the buyer, I would point out the extreme importance for the salesman to develop the proper habit of thinking—the right point of view regarding his work. The representative of a welding contractor is in fact not a salesman in the ordinary sense. He is not like the grocery peddler who calls on the retailer with a standard line of products like sugar or

Use Up-to-Date Directories in Making Up Your Prospect List.

salt to sell. He can't call on his prospects with the attitude "You don't need any pretty welding beads today, do you?"

The Salesman Must Be a Technical Expert

The representative of the welding contractor is in a sense a missionary for the cause of welding. He must portray its advantages and applications to people who know it only slightly or not at all. He is a kind of professional adviser

on metal working. It is his task to make recommendations for better methods of construction and operation into which welding will fit. His problem is to show where savings can be made by welding parts otherwise routed for the scrap heap.

He needs, therefore, to get into the shop and plant of the prospect and observe the conditions and methods of operation. He should have a nose for all kinds and types of applications where welding will fit. Hence, nothing short of

Make Personal Calls on Your Customers and Prospects.

a thorough understanding of welding in its various applications and a creative imagination of the highest order will enable a man to make a real success as a welding service salesman.

Pictorial Perspectus Helps to Sell Welding

In getting over to prospects the idea that welding can be successfully used for one specific application or another—in other words, selling the merits of welding to men who either are uninformed or are skeptical of its virtues—several shops are making use of a very effective pictorial sample kit. They are putting into practice the old Chinese maxim that one picture is worth ten thousand words. They have gathered together photographs of three or four dozen of the best jobs they have ever done, small parts and large, representative of a wide variety of industries and welding applications. They have had large, clear prints made, mounted them on cloth, and bound them in an album convenient to carry and show.

At several places in these remarks it has been suggested that to sell the services of the welding contractor successfully requires initiative, aggressiveness and creative imagination. It is gratifying to find a few shops that are exercising those qualities to a pronounced degree.

For example, we know of one welding-shop owner in a metropolitan city who has gone to a town some 125 miles from his base—a town in which there are several manufacturers of machine tools—and has been able to show these manufacturers where they can make a saving and improve their construction by using welded plates for various parts to replace castings. Though there are several job welding shops in the town where this work is being done, no one of them apparently ever thought of the application.

Another shop owner located in a farming district makes a practice of driving his truck out to various farms in the fall and picking up worn plow shares. These are hauled into the shop, built up and smoothed off during the winter and delivered back to the farmers before they are needed in the spring.

A company in Chicago equipped a large truck with both an electric and a gas outfit, and one of the partners in the business, with a helper, took the truck throughout small towns where welding shops were not established, called on garages, manufacturing plants, and power companies and picked up all kinds of welding projects and handled them on the ground. They have made a good thing of these regular trips.

Some Shops Specialize in Certain Classes of Repairs

Another enterprising shop several years ago got a job of repairing an airplane motor that had been in a crack-up. The shop owner took great pains to turn out an excellent job. This lead to the thought, why not go after more airplane work? From this simple beginning, by making use of aggressive tactics this company developed to the point where they at one time had three salesmen calling on the airports of the Central West soliciting plane-motor repair work.

Another shop makes a specialty of repairing heating boilers in office buildings and apartment houses, hotels and other large buildings. In this case, the shop owner is his own salesman and spends much of his time, especially in the summer and early fall, calling on building owners and managers. But he also makes a very special point to get well acquainted with the building janitors, who sometimes tip him off as to whether a boiler needs repairs. He gets into the boiler rooms and makes inspections of the work needed. Thus armed, he is prepared to make definite recommendations to building owners. When asked how he got such a good stand in with the janitors, he replied, "Well, I oil them up a bit every once in a while."

The Storts Welding Co., of Meriden, Conn., is doing an outstanding job of building good-will for themselves and advancing the interests of welding generally. For one thing, they have gathered together a library of all the good books, papers and magazines dealing with welding that they can find. They issue a standing invitation to anyone interested in welding to come to their office and use this library.

One of the activities that may be used to supplement personal contacts is telephone selling. Although this type of selling needs to be approached very thoughtfully and carefully, a number of shops are using it to good purpose. One of the advantages of using the telephone to sell is that it is so economical. Most telephone companies have a minimum charge, and few welding establishments exceed this charge. Obviously, a man using the telephone for one hour can contact many times the number of prospects he could if he should go personally to their plants, and the effectiveness of those contacts is limited only by the ability and good sense of the man making the call.

The 'phone is useful in building up a list of new prospects. Few companies will refuse to give out general information about their business, provided they are told politely who wants it and why it is wanted.

To Build Up a Garage List, Use the Telephone

For example, let us assume that prior to a campaign of personal selling you are building up a list of the garages in your district who might be prospects for welding service. It is entirely practicable to call up those garages whose requirements are unknown to you and find out if they have welding equipment of their own or have occasion to use welding-shop service, or other information.

Show Your Prospect Pictures of Your Best Jobs.

This plan will eliminate from the prospect list those where there is no chance to get business and will unearth those most likely to yield business. Thus, much time of the personal salesman is saved.

A secondary way the 'phone can be effectively used is as a follow-up and a supplement to personal contact. After a salesman has made a couple of calls on a prospect, he develops an acquaintance with the man and learns something of his personal requirements. In such cases the salesman can in all good part call

the prospect occasionally on the 'phone to give him information about some point brought out in their prior personal conversation, or to tell him about a welding job in line with the prospect's needs which the shop has just done for some other customer. By sandwiching his 'phone calls in between personal visits on good prospects, the salesman can save much time and do a better all-round job of selling.

A third way the 'phone fits in well is when a special campaign is being put on to a certain line of prospects. For example, in the case of the shop that took the truck around among farmers to pick up plow shares, it would be possible to 'phone in advance to a number of farmers on various routes and let them know about the pick-up trip.

Naturally, a few precautions are necessary in 'phone work. Try to call at a time most likely to be convenient for the prospect. If you know that your prospect is a shop man, try to avoid calling when he would have to leave a job to talk with you. Another suggestion is, have something definite to say or else don't call. Think out carefully in advance just how you are going to present your story and try to frame it in the way most likely to interest the prospect and get a favorable response.

The last suggestion is, give the use of the telephone more careful and serious thought and planning. It is a sales tool which almost all welding shops could use with greater profit. And, incidentally, it has a special value to the one-man shop where the owner finds it difficult to get away to make personal calls.

Direct-Mail Advertising Can Be Made Effective

One of the most effective tools a job shop can use in building sales over a period of years—one which is a very positive aid to personal selling—is direct-mail advertising; that is, the use of form letters, folders, postal cards, booklets, blotters and the like. In our contacts with shops, we found that direct mail is commonly used. Some claim it is difficult to trace results from it. Others have very definite proof that it has more than paid its way as a business builder.

Some business men have a very hazy idea of what direct-mail advertising will do as a builder of sales; others expect it to do far more than possible. Consequently, it is well to have in mind at the very outset just what objectives you may reasonably hope to reach through this medium.

If you are just starting in business, you can announce to a selected list of prospects the establishment of your shop and explain the kind of work you do. By sending out subsequent mailings at regular intervals—for example, once a month or once in six weeks—you will keep your prospects reminded of your shop and cause many of them to think of you when they need welding.

If your direct-mail advertising is well handled and done with a fair degree of regularity, not spasmodically, the prospects will get the impression that yours is a live, progressive concern, capable of turning out first-class work. If your direct mail is sent to companies that have patronized you, it will help to remind these customers of the work you performed for them and will aid in bringing repeat business, if your previous work left a good impression. This is a part of that very important asset called "good-will," defined in substance by the U. S. Supreme Court as the tendency of the buyer to return to the source where he has been well served.

Remind Your Customers of the Services You Offer

People in general have poor memories, particularly in regard to the business of others. Even though you may have done

Mr. Telephone Is One of the Salesman's Best Helpers.

work for a certain firm, the individuals in that organization who have the authority to give you an order are likely not to be familiar with all the kinds of work you can do. For example, a firm for whom you have done gas welding may not know that you do electric welding also; one for whom you have welded may not know you can do cutting. If you operate a machine shop, your welding customers are likely not to know about your machining facilities. Hundreds, perhaps thousands, of firms which have had welding of one kind or another done do not realize the wide scope of jobs to which welding can be successfully applied.

By means of direct-mail advertising you can gradually inform your prospects of the full scope of your services and the many uses of welding. One circular or letter might dwell on the success you have had in the welding of tanks, another with repairing broken gears, a third with reclaiming auto parts, etc. By mailing letters or other direct-mail pieces at regular intervals, you are bound to educate most of your customers and prospects as to the complete scope of your services.

Direct mail can also be made effective as an aid to personal selling. It is the Good Man Friday of the salesman. It paves the way for the salesman's call, educates the prospect as to who you are and what kind of work you do, thus relieving the salesman of much "cold-turkey" introductory work and allowing him to use his time entirely for the meat of the selling job—that is, getting an order. Direct mail can be used to follow up and reinforce the salesman's call.

Some shops make a practice of writing each day personally dictated letters to the prospects the salesman has called on. These letters give some additional information for which the prospect may have asked, and they reinforce some of the points brought out in the conversation and serve as a forceful clincher—a double reminder of services your shop can render the client. Where the salesman's calls are infrequent, cards, blotters or other circulars sent out between calls serve to remind the prospect of the salesman and of the welding shop.

Direct-mail advertising will bring inquiries, develop leads which you can follow up by personal calls, and locate many on your prospect list who are interested in your layout. These are the ones upon whom you should concentrate your efforts and try to develop into customers.

You should make it as easy as possible for your prospects to reply. To do this, you can (1) enclose a reply card or envelope showing your return address, (2) offer to send the results of certain tests which have been made by some authority on welding, or (3) offer the prospect a booklet on some timely subject, a supply of which you may very readily obtain from one of your sources of supply. Use your ingenuity and do anything within reason to get him to answer your circular, because with an answer at hand you have a logical reason to make a call and you have something to talk about that he is interested in.

Don't Overlook Advertising That Has Utility Value

One type of direct-mail advertising that is worthy of special mention is that which has utility value to the prospect—something he can use and keep—and in the using of it he naturally is reminded of you. In this category, some shops are making monthly mailings of blotters, others give a small desk calendar at the first of the year. To their better prospects, some shops give an automatic pencil.

I know of one shop where the "boss,"

who does all the selling, carries in his pocket a few stickers about 3x5 in. in size, printed on one side in large type with the name and address of the shop, telephone number and a brief sentence or two emphasizing the merits of welding and the services rendered by the shop. He makes it a point to paste one of these stickers in some prominent place in the office or shop of every prospect he calls on—preferably near the telephone.

If you can find some set of tables, some bit of statistical or engineering information which your prospects can use in their work—preferably something allied as closely with welding as possible—you have the basis of a very effective direct-mail piece.

There is one great advantage of direct mail which many overlook, namely, its low cost. You can send a government postal card for a cent; and when done in quantities, you can have a message printed on them for another two cents each, or a total cost of three cents. As regards envelope mail, it is possible to produce and mail very presentable pieces of various sorts in envelopes at a total cost of five cents each or a hundred for $5.00. Compare this with the cost of personal selling. Including salaries and personal expenses of the salesman, how many calls can he make for $5.00?

If just one circular is well prepared and sent to logical prospects, and the resulting inquiries properly followed up by personal calls, that circular has a chance to show a profit. However, it is unwise to approach the subject of direct-mail advertising with the idea of sending out two or three "fliers" and then stopping. The use of this form of sales promotion should be looked upon as an essential part of a sales program which is followed through indefinitely just the same as the sign is kept on the outside of your shop and your name in the telephone book.

List Your Firm in the Classified Directory

If your shop is located in a town of 10,000 population or more, it is well to give thought to the listings of your firm's name in the Classified Section of the local telephone directory as well as in the City Directory. Most telephone directory publishers grant one free listing in the Classified Section to every telephone subscriber and they sell additional listings for a small fee.

It is good business to be in these classified sections under more than one heading. The headings in different directories vary a great deal from city to city. Some worthy of consideration are:

Boiler Repairing	Metal Workers
Furnace Repairing	Blacksmiths
Engine Repairing	Radiator Welding
Pipe Welding	Acetylene Welding
Electric Welding	

One value of these listings lies in the fact that they catch the transient prospect—the break-down job of the man who is passing through town. Another value is that the prospect you called on months ago may have forgotten your name and the name of your company, but remembers you were a welder. Now he needs your services and about the only way to find you is through the classified directory. Some prospects will not think of you so much in terms of welding as in terms of the problem they have. For example, a man needing a boiler repaired may look under the heading "Boilers," and one needing a casting repaired might look under "Castings."

Admittedly, it is not always easy to count up at the end of the year and arrive at a figure representing the business brought in by directory listings. However, the cost of extra listings is so low that one or two can be bought for as little as $24 per year. In the early part of this paper, I mentioned three shops who were highly successful and did no selling at all. It is interesting to recall that one of these shop owners was enthusiastic in his remarks about the value he had gotten from telephone directory listings.

Keep Your Shop Neat and Tidy.

Owing to lack of time, newspaper advertising will have to be passed over. However, it should be mentioned that a few shops have published and are publishing advertisements at intervals in their local newspapers with satisfactory results.

Radio Advertising Has Brought Business

Radio advertising is another medium which a few shops have used to a limited extent. For example, a shop in Jackson, Tenn., ran a brief announcement on a noon-day program for a week and as a direct result landed one big job, the profit from which more than paid the cost of the broadcast. I could name other successful radio campaigns.

In this matter of selling, there is one final factor that should by all means be mentioned, and that is appearance and orderliness. Appearances in business have a cash value. Because of this fact, bankers surround themselves with mahogany furniture, oriental rugs and expensive paintings; retail stores install elaborate show cases and display fixtures, and restaurants spend much money for wall decorations and inviting atmosphere.

Good Appearance Leaves a Good Impression

One of the most important business fundamentals is that customers and prospects judge on appearances. Business houses are continually putting forth effort to develop those appearances that will make good impressions.

The welding shop is not immune to this fundamental. It is true that probably no shop ever will go to the extremes of buying ornamental grills for the windows, mahogany furniture for the office, and full dress uniforms for the welders, but there is a neatness, an orderliness and an air of system that do fit in with the welding contractors' business and which pay high returns on a small cost.

Take the outside of your building—is it in good repair or does it look like a tumbled-down shack? Your office—is it clean, orderly and business-like, or does it resemble your scrap pile? Your shop—is it conveniently arranged, with an air of system, a place for everything and everything in its place, or is it a hodge podge of gas tanks, discarded parts, new work and junk? Your auto truck outfits—are they newly painted, in good repair, bearing signs which proclaim in a favorable manner the name of your company and line of business, or are these outfits something the junk dealer would blush to own?

Make no mistake about it, all these points and others are noticed and make conscious or sub-conscious impressions on customers, prospects and all who see them. If the sum total of these impressions is good, it is a sales help; if bad, a sales loser.

In conclusion, may I repeat what I said early, namely, that there is a great need for the job-shop owner to become a better sales manager. And may I suggest that to become a good sales manager one needs not only to develop the attitude of an aggressive business promoter, but he needs continually to study the various detailed phases of the job. To succeed as a personal salesman or as a director of salesmen, he should read about the experiences and methods of successful salesmen in his own and other lines, talk with salesmen, and observe the tactics of men who call on him. To operate a successful direct-mail campaign, he should talk with direct-mail service organizations, creative printers, and read about winning campaigns.

In my opinion, if the job-shop owner will give as much thought and planning to the selling and sales promotion department of his business as he does to the practical welding side, there is a much brighter day ahead for him and for the industry.

Using Tests to Determine Correct Set-Up and Procedure for Welding

■ By J. THOM

Superintendent of Welding,
Messrs. Armstrong Whitworth & Co.,
Newcastle-upon-Tyne, England

OVER a period of several years we have tested mechanically and otherwise all sorts and conditions of metallic arc electrodes. The results of these tests show that the type of electrodes used, and the settings on the welding machine, have equally as much to do with good welding as the laying down of the electrode. These points should be settled upon and given to the operator as an instruction before he commences welding. Our conclusion is that for all welded work subject to variable stresses, and particularly reversals of stress, medium-fluxed electrodes should be used, the principal feature of this flux being to create a shield of inert gases round the arc and thereby exclude oxygen and nitrogen, both of which are definitely detrimental to good welding and weld metal.

Generally, it is found that a bare-wire electrode will not give results sufficiently good to be used where there is any tendency to fatigue. But in large welded structures, where all that is necessary is a good tensile strength, there is, of course, a definite saving and a larger field for the use of bare-wire and light-coated rods.

We consider that extended tests on different makes of electrodes are desirable. The tests, as we carry them out, are made on three specimens for each type of electrode.

THE author gives the results of tests conducted with various types of electrodes and submits reasons for using high welding currents. His firm, through a continual check of their welders' work, prove that they are obtaining consistently high strength values of welds, which figures they use in the design of structures. This article was received through the courtesy of The Lincoln Electric Co.—Editor.

Preparing the Welded Specimens

On all tests welding is caused to proceed at a uniform rate, and the slag is chipped and the weld carefully brushed on the surface before a new layer of weld metal is added, if this is necessary for the particular type of electrode being tested. The welding time is noted particularly; and as the weld progresses, characteristics of the electrodes are recorded, such as ease of manipulation, evenness with which the arc burns, the characteristic way in which the slag tends to distribute itself over the weld, ease with which the slag can be removed and whether this is better done hot or cold, amount of spatter, uniformity of the layers of weld metal, and penetration. This last observation is best made by etching the specimen with a 1% to 5% solution of nitric acid.

Such tests as these may show that it is advantageous to use an expensive electrode rather than a cheap one. This is explained by the fact that the expensive electrode may give as low as 7% of spatter as against anywhere up to 25% of spatter for the cheaper rod. Or, again, it may be found that the time spent in removing the slag left by one electrode more than counteracts the difference in price of another electrode.

High Currents Tend to Eliminate Slag and Porosity

The net result of our conclusions from these elaborate and varied tests is that high currents are conducive to good welding and are particularly advantageous for the elimination of slag and gas holes; also, that the wastage of metal at high currents compares very favorably with any other method of running electrodes.

With an amperage of 70% to 100% above what is normally used today (with what I may call normal-current rods) the weld metal is free from included slag and gas holes. Moreover, the use of high amperage is not detrimental to the parent metal.

High currents show most decided advantages from a cost point of view, which is, of course, a most important factor. In high-amperage practice today, a ⅜ in. electrode, 14 in. long, containing 0.375 lb. of metal per foot of rod, can be deposited at 450 ampers in a period of 65 seconds. With a 2-to-1 ratio of preparing and starting time to welding time, the rate of deposit is 0.375 lb. in 195 seconds, or, allowing 10% wastage, 0.338 lb. of metal in 195 seconds, which is equivalent to 6 lb. of weld metal per hour. Actually in practice on a long run of weld we have deposited 8 lb. of weld metal per hour under these conditions. These figures are, roughly, 3 or 4 times the rate of deposit with what may be called normal amperages.

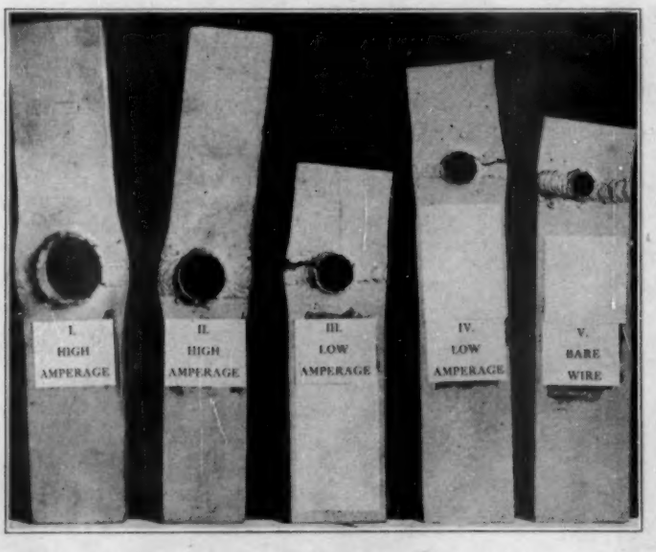


Fig. 1. Ductility Tests Made by Cold-Drifting a Drilled Hole Through the Weld. Specimens I and II, Welded With High Currents, Show the Best Results.

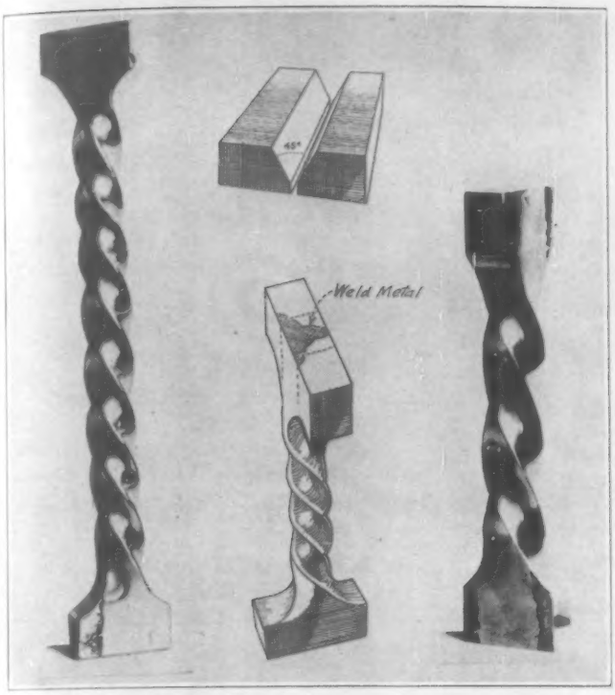


Fig. 2. Two Specimens Cut From a Welded Boiler, Then Machined Down, and Twisted in a Vise.

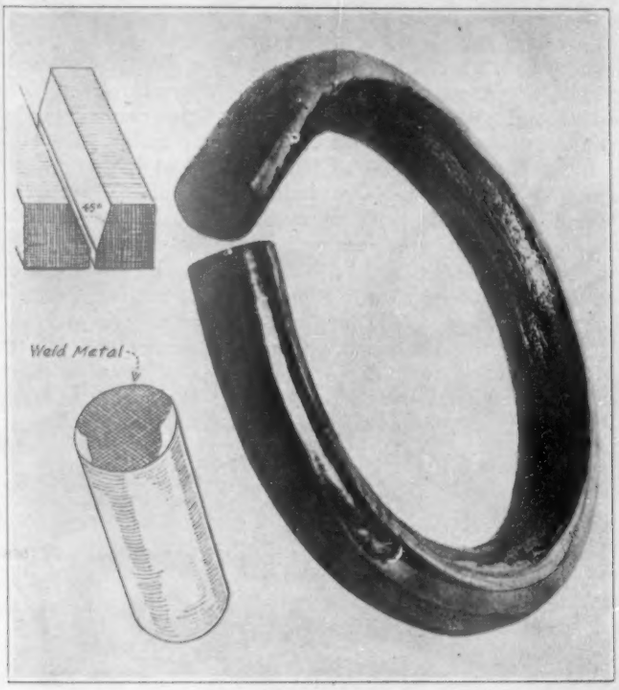


Fig. 3. This Round Specimen, Bent, Then Immersed in a Hydrochloric-Acid Mixture for Two Weeks, Shows No Sign of Corrosion.

We now come to the consideration of the first fundamental of good welding, that is consistency.

It is not necessary that for a given size or area of weld, the tensile strength and other characteristics of the weld metal be identical; but it is vitally necessary that a firm using a process to any large extent should be quite satisfied in their own minds that a weld made today will give the same strengths and characteristics as a weld made a week or a month hence, even though these may be made by different operators in their employ.

Maximum Variation of 7½% in Butt-Weld Strengths

In actual practice, butt-welded joints under test should not vary in their high and low figures more than 7½%, which figure is within the latitude allowed in the British Standards Specification for mild-steel plate. To keep within the limits of this figure with certain types of electrodes is, in workshop practice, sometimes rather difficult.

After studying the results of various tests with high- and low-current welding, I am satisfied in my own mind that a tolerance of 7½% in test results is easier of attainment by using electrodes at high amperages, as this entirely eliminates slag and gas holes, which in my opinion are the main cause of variations in the results obtained from tensile and other tests of welded joints.

With an impact test (assuming mild steel to break at 40 to 60 ft.-lb.) a test piece of all-weld metal, or a test through a welded joint, should equal the figure for mild steel or give one slightly higher; in no case should the result be lower.

If these figures can be obtained consistently, the strength of welds and welded joints can be calculated in the same way as mild-steel plate, where the properties required are covered by these test results.

The accompanying tables give the results of several tensile-test and impact-test specimens selected from tests carried out over a lengthy period, and include the highest and lowest result obtained during that period. These results, it will be noted, come within the 7½% tolerance I have set, and can safely be taken as results that consistently accrue in welded structures as manufactured and fabricated by the firm who have carried out these tests.

A welded joint of any description should definitely show resistance to corrosion and disintegration at least equal

Average Results Selected From Test Records of Welded Butt Joints Covering a Period of Two Years

(1 Long Ton = 2,240 Lb.)

Date of Test	Dimensions of Test Piece	Yield Point, Long Tons per Sq. In.	Breaking Stress, Long Tons per Sq. In.	Reduction of Area	Remarks
11/6/31	2½x½ in.	22.1	29.9	22%	As-welded condition. Faces machined to plate thickness.
1/28/32	2½x½ in.	22.2	30.65	21.8%	"
7/19/32	3x⅝ in.	22.8	31.1	21.6%	"
12/15/32	3x⅝ in.	22.24	31.0	21.8%	"
2/7/33	2½x½ in.	22.1	29.0	22.2%	"
7/5/33	2½x½ in.	22.55	31.2	21.6%	"
9/14/33	2½x⅝ in.	22.2	30.4	21.8%	"
		All-Weld-Metal Test Specimens			
12/7/31	6x¾-in. dia.	22.8	29	38%	Built on ½-in. plate and machined. Tested in as-welded condition.
12/21/31	6x¾-in. dia.	21.2	27.92	63%	Built on ½-in. plate and machined. Normalized at 750° C. before testing.

Izod Impact Test Results Selected From Test Records Covering a Period of Two Years

Date of Test	Dimensions of Test Piece	Impact Breaks, Ft.-Lb.	Average of Test, Ft.-Lb.	Brinell Number	Remarks
6/1/31	5x⅝-in. sq.	64 63 59	62	121	No signs of slag.
11/6/31	"	64 60 46	57	113	"
1/28/32	"	60 58 48	55	112	"
3/1/32	"	55 49 65	56	117	"
5/18/32	"	54 50 58	54	110	"
		Mild-Steel Plate			
12/15/31	"	67 46 49	54	113	Longitudinal section.
12/15/31	"	29 33 26	29	113	Cross section.

to the resistance of the parent metal.

There are various methods of testing for resistance against corrosion and disintegration. A good example is for the test piece to be suspended at a river mouth so that at low tide the test piece is out of the water, and at high tide immersed in the water. One disadvantage of this test is the time required to complete it; the minimum period being about six months.

A quicker method usually adopted is to immerse the test piece in a mixture of 50% hydrochloric acid for a period of approximately ten days. Another method is to immerse the test piece in a bath of 20% solution of sulphuric acid for a period of approximately three days; it may be found by intermittent inspection of the test piece that considerably less than three days will be sufficient.

We have carried out corrosion tests with all makes and types of electrodes, and in some cases the results have been astounding.

Slag Inclusions and Oxidation Accelerate Corrosion

The failure of any weld to stand up to this test seems to be caused by slag inclusions when covered rods are used, and oxidation, when bare wire is used. In fact, so erratic are the results of a weld made with bare wire that I would not advocate this type of welding on any structures where even small variances in stresses are liable or likely to take place. I have also found great variations with different makes of covered rods. When using covered rods, however, I find that the higher the current at which the rod can be run, the less will normally become the slag inclusion.

It may be thought that I am placing too much stress on this point, but it enters very greatly into the uses that may be made of welding, and the requirements of welded structures. So far as corrosion and disintegration are concerned, it is required that weld metal be equal in all respects to the parent metal.

Freedom from slag and gas holes in all welded joints is a vital necessity if welds are to be treated and calculated on a fixed basis, as definite figures are used today for mild-steel plate and sections.

You will appreciate that if the outside dimensions of a weld are used in calculating the strength of that weld, and any percentage of that weld is composed of slag or gas holes, the calculation can lead one very sadly astray.

After numerous tests on work which has to withstand great stresses, I invariably use high-amperage rods, and wherever possible the structures are so placed that the welding will be done in a flat position. Flat welding should be employed wherever possible, even if it means considerably more lifting and cranework, as the results make it assuredly well worth while.

On a large number of railway mobile structures, as, for instance, Diesel-engine crankcases, ductility and resistance to fatigue are, of necessity, two of the most important requirements of welded joints. For general usage, these properties should equal at least 90% of that obtained from any good mild steel, and, again, all results obtained by test must be consistent if this figure is to be used as a basis of calculation, with the difference in this case that, on structures which come under this category, all firms or manufacturers should work within this range. These qualities are again largely governed by freedom from slag and gas holes in the weld metal and from oxidation. In practice, these are two of the tests under which bare-wire welding fails miserably.

Fig. 1 shows five weld specimens tested for ductility. This test is carried out by drilling a ¼ in. hole through the center of the weld metal, and drifting the hole by cold drifting until the weld shows signs of fracture or collapse. These results are typical of those we normally get from this test with different types of electrodes.

Methods for Making Fatigue Tests

The test for fatigue is conducted with an all-weld-metal test bar, machined to required dimensions and revolved in a lathe eccentrically loaded just within the elastic limit. If the test piece withstands five million reversals of stress, it is considered equal to mild steel.

Perhaps a better test for fatigue is to take a butt-welded test piece, and vibrate it with a given load through a definite angle until it collapses. It can then be compared with the collapse of a specimen of mild-steel plate under the same conditions. This gives a definite and comparative result of the ability of a welded joint to withstand fatigue compared with the solid plate.

By setting a vibrating or fatigue-testing machine so that a piece of mild-steel plate fractures with approximately 6000 reversals, we find that test pieces made with different types of electrodes will show signs of fracture at approximately the following number of reversals: Mild-steel plate, 6000 reversals; a weld made with high-current covered rod, 5500 reversals; a weld made with low-current covered rod, 5000 reversals; welds made with cheap paste rods, about 1500 reversals; and a weld made with bare wire, 500 reversals.

The foregoing results should give the necessary data required for designing as applied to welded joints and structures, with the exception of fillet welds.

We have done a large amount of fillet weld testing, and the actual results come within the limits set for butt-weld work, but the welding must be properly carried out and done in the correct position.

Fig. 2 shows two specimens that have been cut from a welded boiler and twisted in a vise. The weld is through the vertical center of the plate in both cases. These pieces were machined down before twisting until the resultant cross-section was composed of 80% weld metal and 20% parent metal. The twisting was done in the as-welded condition, without annealing. There were no signs of fracture in either piece after the test.

We obtain certain results consistently on the testing machine, and all our calculations for structures are based on these tests.

Required Results of Tensile Tests

In the tensile test the specimen must give 28 long tons (1 long ton = 2240 lb.) per sq. in. and a yield point of 22 long tons per sq. in. with a maximum variation of 7½%. The figure we require on the impact test is between 40 and 50 ft.-lb. In the elongation test, we drill a hole, ¼ in. in diameter, through the weld metal and obtain an elongation of 34% to 40%, and approximately 20% in 2 in. In a fillet weld, the maximum tensile strength on a section through the throat of the weld must lie between 20 and 22 long tons per sq. in.

A bend test is also applied, in which we require a butt joint of ⅝-in. plate to be bent over on itself in a hot condition, and to an angle of 110° in a cold condition.

A butt joint in a ⅝x2½-in. bar is also cold drifted from ¼-in. to 1⅛-in. diameter, without any sign of fracture occurring.

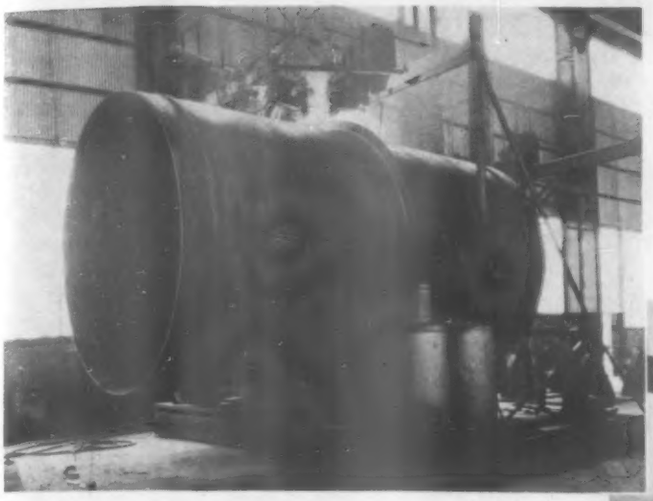
The result of a corrosion test is shown in Fig. 3. This round specimen, composed almost entirely of weld metal, was bent into a circle and immersed in a hydrochloric-acid mixture for a period of two weeks. There are no signs of disintegration or corrosion. Our requirements are that the weld metal withstand the corrosive action of the solution at least equal to the parent metal.

St Louis Group Hears Talks on Plate Work

At the regular meeting of the St. Louis Welding Society held on Feb. 23rd, H. T. Pott gave a talk on the applications of arc welding to steel plate, structural shapes, fabricated shapes, etc., including the production of steel barges, pontoons and towboats for the U. S. Government. Mr. Pott is president of the St. Louis Shipbuilding & Steel Co. and was formerly an official of the St. Louis Structural Steel Co. For several years he has been directly associated with the building of steel watercraft.

Views from Boulder Dam

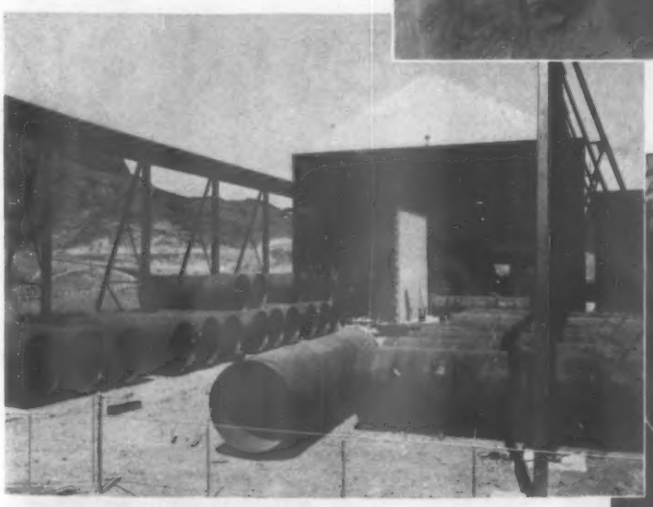
Photographs supplied by The Babcock & Wilcox Co.



■ Welding girth seams on 13-ft.-diameter pipe with automatic welding head at the field fabricating plant of The Babcock & Wilcox Co.

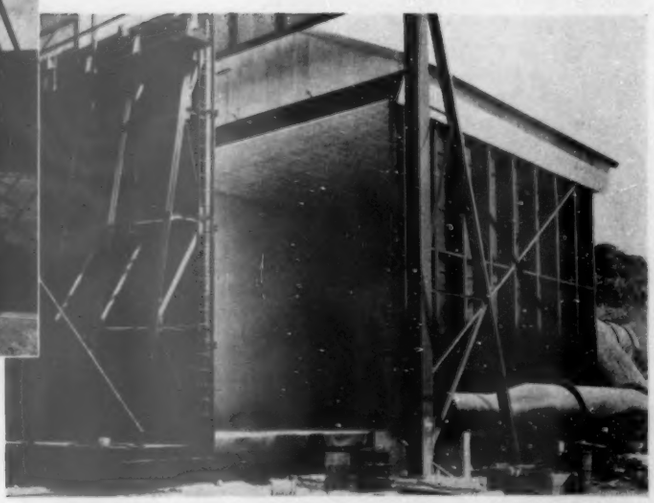
■ Completed 13-ft-diameter sections, showing stiffener ring and support brackets assembled on pipe.

■ View from Lookout Point, showing first 8½-ft.-diameter pipe section being transported along bench for installation in outlet tunnel.



■ Storage yard at the field fabricating plant of The Babcock & Wilcox Co. at Boulder Dam, showing 8½-ft. welded pipe sections, ready for installing.

■ This furnace, at the field fabricating plant, will stress-relieve pipe sections as large as 30 ft. in diameter and 24 ft. long.



Get "*H. O. T.*" on Welding

■ Edited by
H. O. T. RIDLON
Welding Consultant, Joliet, Ill.

[This section is dedicated to Better Welding and Better Welding Shops. Suggestions and criticisms are invited.]

The Thought for the Month

Most of the things we know were told us by somebody who heard them from somebody else who was told by somebody, and so on far into the night. Think that one over some time when you're feeling as though you were a pretty smart egg, and see how much you actually know. Put a little reverse English on it like this: We know 2 and 2 makes 4; that 1 and 1 makes 2; but what the hell is 1?

Can You Stand Another Year of HOT's Stuff?

Gosh, how true is the old saying "tempus fugit," which, I am told, means "time flies" in the language of us guys. For it was just a year ago our editor and I decided that we'd try my line of chatter on the unsuspecting public for three months. And now here comes No. 12. You birds have been very kind to the Old Maestro. Not many flash-backs, and many nice remarks. And I thank you all so very much. I've tried hard in my small way to be a help to all you welding operators and job-welding-shop owners, and I sincerely hope I have. But I would like to know if it has been at all helpful and if you, my friends, want me to carry on. It's up to you! Will you take time out to drop old "HOT" a line?

Those Two Busy Brothers Spring a New One

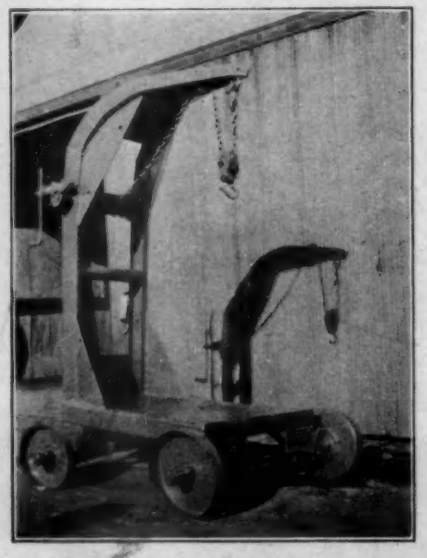
Those two brothers are hard to keep up with that I've been talking about for the last few months. They don't want their story told completely yet, but I have got some news items on them for you. Well, it seems their building wasn't adequate for their work, so they stepped out and bought themselves a lot across the street. Remember, in December they were broke, or darn near it. They got wind of Robt. Hale in Chicago — that young fellow who specializes on welded buildings. (He seems to know his stuff along those lines.) He designed them an ideal welding shop and they are building it now. By the time this goes to press they hope to be in their new shop. And what a swell place it is going to be! Just the kind a guy dreams of, hopes for, and seldom gets. And now those durn monkeys have sprung another one. A town about 20 miles from them was sending them a lot of business, and so they have opened a branch there; and they threaten me with this news, that within a year they will have ten branches about 30 to 50 miles apart. They sure have a system of getting the "biz" that clicks.

Sell 'em, brothers! Get out and sell, darn your old hides! Welding can be sold. But keep it sold by making every weld as near perfect as you can. Keep your shop, equipment, methods, and yourself up to date.

Step This Way, Gents, and Receive Your Prizes

Well, I'll be durn, look here! Ogle Wilson, from that great state whose capital is Show-me, crashes through for the first prize in the "HOT Contest." Congratulations, me lad! You win, not only because it's a good hoist you have made, but my New England ancestry has taught me to admire those who are frugal and make useful things out of scrap. This young fellow runs the Wilson Welding Shop at Norborne, Mo. Here's the picture of his hoist, and this is what Mr. Wilson says about it:

"This hoist is very handy for handling large welding jobs. It handles a car or truck very easily. All parts used are old automobile parts. The wheels are old brake drums welded onto Model T Ford hubs. Model T axles were shortened to



A Handy Truck Hoist Welded Out of Scrap Material.

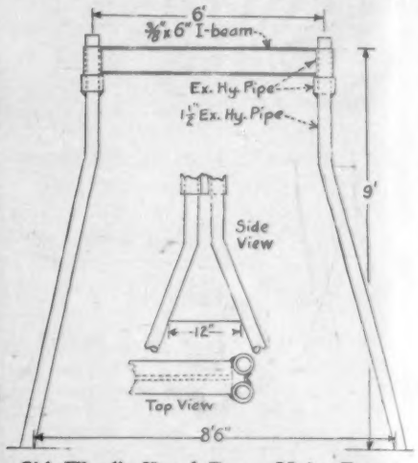
40 in. by welding and cutting. An old steering gear was used for power. The chain pulleys were made from two pieces of plate with a piece of 2-in. pipe welded in between. The boom was made from an old frame, and all other parts were auto parts. This hoist is cheap to build, but it does the work."

Mr. Wilson is a bit vague on some details, but if any of you smoke-eaters want to build one like it, I'm sure if you write Wilson he'll give you the low-down.

• • •

And next to receive more fame and glory is my old tried, true and trusted friend, "Sid" Ward of Aurora, Ill. Sid's truck carries the sign, "Ward the Welder," and I've often wondered why some wise-cracker hadn't changed the "the" to "off." But I'm proud to do honor to Sid, for he is one of the real old-timers in the game. He is a fine gentleman, an artist with the oxyacetylene torch—yes, the dean of welders, and a real man. I wish every welder in our broad land could have the privilege of knowing Sid as well as I do. He's an inspiration to any young welder. If any of you fellows are near Aurora, look up this swell guy and I'm sure you'll enjoy knowing him.

Well, Sid gives us a design for a portable and knock-down hoist that he built



Sid Ward's Knock-Down Hoist Frame.

18 years ago, and it's still doing plenty of heavy duty. Put a good chain hoist on this I-beam, and you can lift a real load. You can pull the thing apart, put it in the back of the old flivver, put the back in place, and cart it down the street. Or shove it into a corner out of the way until you're ready to use it again. It's a great hoist—and that's one tool a welding shop can't do without.

• • •

From out Kansas way comes the third winner. It's A. D. Jackman, who runs Jackman's Shop at Rossville, Kan. Here's his story and picture of his C-clamp. Smart idea I calls it.

"I am sending a sketch of a C-clamp I made from an old auto jack and an engine hanger cross member welded to the edge of the jack," writes Mr. Jackman. "They are easy to make and can be built from parts found in any shop, and will stand more rough usage than the ordinary C-clamp you buy. I have found this type of clamp very useful."

• • •

Among those contributions deserving honorable mention is one from Frank J. Pelz, proprietor of the Hinkey Portable

Welding & Machine Co. at Sandusky, Ohio. This is a gadget for lining up trailer wheels, and should come in handy some time to some of you fellows who do trailer work. Here's Pelz's story:

"Below find sketch for lining up trailer wheels when building up long trailers. It is built up from old trailer parts. A small spring scale is attached to a heavy cord with a loop in either end; one end to slip over a nail or welding wire and other end to scale; nail entering center of king-pin. Cord to extend to rear wheels with scale tied to other end of string. Scale reading same on either wheel. I find this a better plan than using steel tape."

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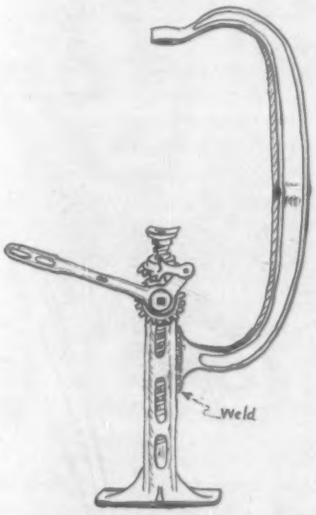
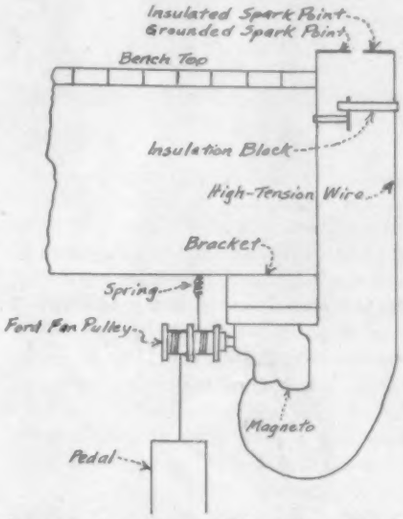
Ivo V. Pennington, of Pennington's Garage, Wauneta, Nebr., brings us an idea of which we have seen many variations. But his scheme is good and may be



C-Clamp Welded Out of Auto Jack and Engine Hanger Cross Member.

helpful to many of you guys who won't buy economizers or spark lighters and insist on using matches. Here's his story: "Here is a timesaver for the welder that I constructed at a cost of only a few dollars and which I would have a hard time getting along without. My bench is steel frame and brick top. The spark gap is made of ⅛-in. welding rod sharpened to a point—one piece welded to the frame of the bench and the other welded to the top of a bolt and fastened to a heavy fiber block (part of a fuse block from an old Reo) which in turn is bolted to a

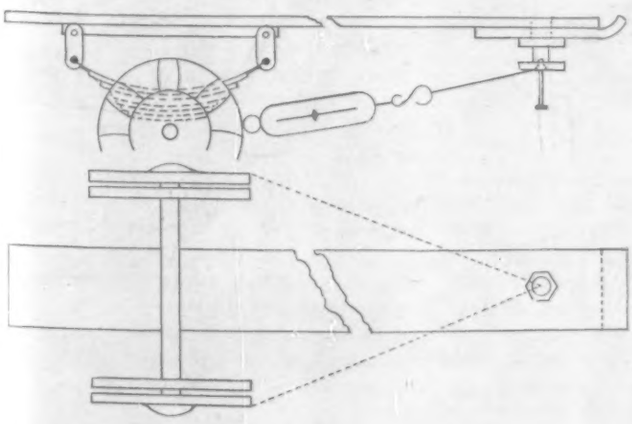


Here's a Stunt for Lighting Your Torch With Your Foot.

piece of angle iron welded to the frame of the bench. The bracket for the magneto is a piece of car frame welded with the open side up to the leg of the table and to the cross brace. The magneto is an obsolete model with good points and bearings and of the type where the high-tension lead comes out in the open where you can connect to it. Otherwise you would connect the high-tension wire to all the posts on the distributor block.

"To the gear that fits the shaft we welded a fan pulley from an old 1913 Ford, which has two separate spools with a flange between. We use a piece of stranded steel wire to go to a screen-door spring at the back of the bench to return the magneto, and wind four or five turns on the other spool that goes to the pedal, which I made from the top of a wooden battery case (½ in. thick by 4 in. wide and 14 in. long). Be sure to wind the last wire in the right direction to turn the magneto in its correct rotation, which is generally marked on the rear oil cap or can be ascertained by experiment. The spark gap should be 3/16 in. wide and the wires should stick up far enough so that the soot from lighting the torch will not foul the fiber block. Even then it will have to be wiped every week or so with a dry rag.

"We have an automatic torch, and we can lay it down, move a casting, pick it up and light it again without ever raising our goggles or laying the welding rod down to pick up a lighter. This saves gas and also time. Even with a regular torch it saves time and the cost of flints, as a good second-hand magneto can be purchased for $2 and will last a lifetime if the bearings are packed in vaseline when it is put into service."



Scheme for Accurately Lining Up Trailer Wheels.

Thermit Repair Releases Street Cars After Tie-Up

When the main drive shaft at a power house of San Francisco's Market Street Railway Co. let go recently, three streetcar lines were tied up completely. The break occurred at 3:30 o'clock on Saturday afternoon. To obtain a new shaft and install it would have taken weeks and would have meant a complete shutdown during that time.

A Metal & Thermit Corp. representative was immediately called to repair the shaft by the thermit welding process, and he camped on the job until the following Monday. A crew was recruited from the railway's track welding gang and preparation for welding was under way by 5 p. m., Saturday. All Saturday night was consumed in preparing the fracture and assembling the welding equipment and materials. Preheating required until mid-afternoon on Sunday, when the weld was poured. By midnight the metal had cooled sufficiently to permit stripping off the molds, and by 3 a. m. Monday the job was completed. This was in ample time for cars to start running on their regular Monday morning schedules.

The shaft which was fractured is 18½ ft. long. It has a large drive gear in the center and a cable drum at each end and one each side of the drive gear. The break occurred at a shoulder of the drive-gear seat and bearing where the diameters are 10½ in. and 13½ in. The repair was made with the shaft in place, and required a minimum of dismantling. The results, aside from the speed with which the job was done, were remarkable, in that after welding the shaft was less than 1/32 in. out of alignment—less out of line, in fact, than it had been before. The repair is, of course, a permanent one and the shaft may now be considered as strong and as sound as new.

A view of this job, taken at the instant the thermit mixture was set off, is shown on the front cover of this issue.

Book Reviews

SYMPOSIUM ON CAST IRON. 6x9 in.; 164 pages; 85 figures and 37 tables. Paper binding; price, $1.00. Cloth binding; price, $1.25. Published by the American Society for Testing Materials, 260 S. Broad St., Philadelphia, Pa., and American Foundrymen's Association, 222 W. Adams St., Chicago, Ill.

The compilation and correlation of the material in this book was directed by an advisory committee consisting of outstanding technologists in the industry appointed by the American Society for Testing Materials and the American Foundrymen's Association. The book comprises seven broad divisions, including metallurgy, properties, classification and specifications, heat treatment, white and chilled irons, welding, and foundry factors of importance in production of iron castings.

The 80-page chapter on "Properties" is particularly valuable, as it treats fully of the series of alloys under gray and white cast irons. Valuable data from many sources are concisely given with other hitherto unpublished material. The various physical constants and mechanical properties are detailed and there are data on creep, damping capacity, effects of elevated temperatures, machineability and wear, corrosion, and heat resistance.

THE BOOK OF STAINLESS STEELS, edited by Ernest E. Thum. 6x9 in.; 631 pages; replete with diagrams, photographs, and tables. Cloth binding; price, $5.00 postpaid. Published by the American Society for Metals, 7016 Euclid Ave., Cleveland, Ohio.

This treatise consists of 74 papers by authorities on research, fabrication, founding, heat treatment, and uses of stainless steels. These papers are classified into four general groups under the headings of "Production and Fabrication," "Properties of the Typical Alloys," "Requirements of the Consuming Industries," and "Classification." Discussion is given of rolling-mill and foundry practice, and the manufacture of seamless tubing is described. Practices in machining, forging, upsetting, punching, forming, pickling, heat treating and finishing are described, and consideration is given to various forms of welding, including gas, arc, and resistance. Chromium plating and the manufacture and use of bi-metal sheets are also considered.

Part II includes discussions on properties of the 5% chromium steels, low-carbon and high-carbon steels, chromium ferrites (containing 16% to 20% chromium), alloys of 25% to 30% chromium, the austenitic 18-8 alloys, and higher alloys. In addition to properties, consideration is also given to the effect of various additions of other elements, to applications, and to the use of these alloys in castings, forgings, and rolled plates and shapes. A discussion of the control of intergranular corrosion in the 18-8 alloys is ably presented.

A section is devoted to the requirements of the consuming industries, such as the chemical, food, metallurgical, building, transportation, and power industries. Since such applications require a determination of long-time properties of these steels, this topic is considered in papers on corrosion, oxidation, creep and endurance.

The concluding paper presents a short-hand classification of all the commercial types of stainless steels produced in America. A comprehensive index is included.

NATIONAL METALS HANDBOOK. 1933 edition; 4½x7 in.; 1453 pages; replete with diagrams, photographs, and tables. Flexible binding; price, $10.00. Published by the American Society for Metals, 7016 Euclid Ave., Cleveland, Ohio.

This handbook, now in its third edition, is a compilation of scientific data and authentic information on 231 ferrous and nonferrous subjects. It represents the combined authorship of over 200 technicians who are authorities in their respective fields.

All articles are classified under seven major headings: General and miscellaneous data; the constitution of matter; structure; properties; testing; technology; and application. Consideration is given to testing, heat treatment, grinding, cleaning, constitution, properties, mechanical working, welding, surface treatments, applications, micrography, pyrometry, and methods and equipment employed. Among the nonferrous metals considered are aluminum, copper, gold, lead, magnesium, nickel, platinum, tin, and zinc. A general index is included.

WELDING AND ALLIED PROCESSES FOR ENGINEERING PURPOSES, by Arthur Stephenson. 6½x9¼ in.; 67 pages; 42 illustrations. Paper binding; price, 2s. 6d., postpaid. Published by the Royal Society of Arts, John Street, Adelphi, London, W.C.2, England.

This collection of Cantor Lectures, delivered before the Royal Society of Arts in March of last year, begins with a brief historical introduction dealing with the early making of iron by the forging and fusion processes. Equipment required for gas and arc welding are described somewhat in detail, including methods for producing fuel gases. The resistance-welding processes are also described. A discussion is given of materials for welding, preparation for welding, effect of welding on properties of materials used, and testing. In conclusion, the author discusses such allied processes as flame cutting, metal spraying and surface hardening, and describes some interesting applications of the welding processes.

Because of a necessity of covering the entire field in only a few pages, the author has had to limit his discussion to historical information and a general outline of the subject.

BOOK OF A.S.T.M. STANDARDS. Part I—Metals. 6x9 in.; 1002 pages; with illustrations and tables. Cloth binding; price, $7.50. Half leather binding, price, $9.00. Published by the American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa.

This book, which is published every three years, contains all the standard specifications, methods of testing, definitions, and recommended practices adopted by the society. It is issued in two volumes or parts. The first volume, which is the one reviewed here, includes all the 185 standards relating to metals; of these, 104 cover ferrous metals, 70 relate to non-ferrous metals, and 11 involve metallography and general testing methods. A number of specifications are given for steel suitable for fusion welding. These include structural steel for bridges, buildings, locomotives and cars, and ships; boiler and firebox steel for locomotives and stationary service; steel plates for marine boilers; open-hearth iron plates of flange quality; iron boiler tubes; welded and seamless steel pipe; pipe flanges for high-temperature service; and steel wire for concrete reinforcement. The standards on metallography and testing would in themselves make a rather complete textbook on these subjects.

INDIVIDUAL AND COLLECTIVE BARGAINING UNDER THE N. I. R. A. 9x6 in.; 37 pages; 7 tables. Paper binding; price, $1.00. Published by the National Industrial Conference Board, Inc., 247 Park Ave., New York, N. Y.

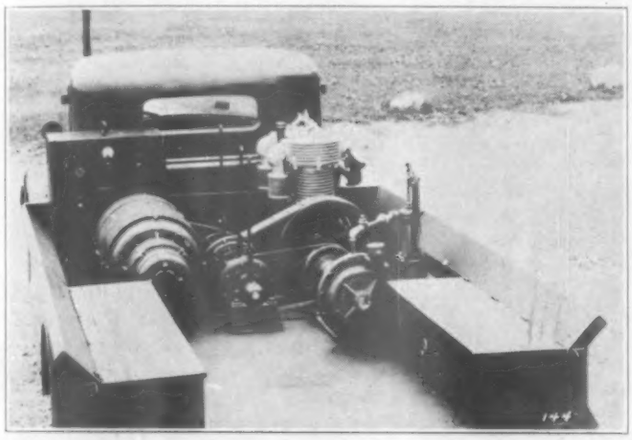
"Events of the last few months have led to much questioning as to whether industrial employees generally have availed themselves of the statutory privileges conferred by Section 7(a) of the National Industrial Recovery Act to bargain collectively with their employers through representatives of their own choosing, and, if so, what form of collective bargaining they have elected to use. In order to obtain first-hand information on this subject the National Industrial Conference Board has conducted a nation-wide survey, the results of which are set forth in this monograph. The study provides a significant indication of present trends in the field of employer-employee relations."—From the "Foreword."

New Equipment

Universal Welders Now Truck Mounted

An easily portable working tool for welding shops and contractors consists of a Universal shunt-inductor type of welder mounted on a motor truck and driven by the truck engine. This device was developed through the cooperation of the Universal Power Corp., 1719 Clarkstone Road, Cleveland, Ohio, and the Ditwiler Manufacturing Co., Galion, Ohio, on the Ditwiler Redi-Service Truck, using Ditwiler power take-offs.

The photograph shows the useful combination of welder with an air compressor for chipping, cleaning and cold-working. The power take-off is interlocked with the engine governor so that the welder operates at governed engine speed. The truck can be driven only after the power take-off is disengaged.



View of Universal Welder on Truck, With Air Compressor and Power Take-Off.

Kester Develops New Aluminum Solder

A new aluminum solder for welding shops and garages has been developed by the Kester Solder Co., 4201 Wrightwood Ave., Chicago, Ill., and will be sold through automotive and welding supply jobbers. Like the Kester Acid and Rosin Core Solders, this new solder is also flux filled. The illustration shows the handy 1-lb. spool, which carries a complete instruction leaflet describing the step-by-step Kester method for aluminum soldering.

Kester Aluminum Solder Can Be Obtained in One-Pound Spools.

Shielded-Arc Electrode for Hard-Surfacing

"Wearweld," a new shielded-arc electrode for building up steel surfaces to resist shock and abrasion, has been announced by The Lincoln Electric Company, Cleveland, Ohio.

Deposits made with this electrode are air-hardening alloy steel with an unusual combination of hardness and toughness, according to the manufacturer. Wearweld can be used to build up all steels other than those of the austenitic type. It is said to be particularly valuable for facing parts subjected to rolling or sliding abrasion, batter, sand abrasion and repeated impact.

The deposited metal has exceptional hardness, depending to some extent upon the composition of the base metal. A single layer on mild steel has a hardness of 40 to 45 Rockwell C. Additional layers will have a hardness of 48 to 52 Rockwell C, it is claimed. On .70 carbon steel, a single layer will have a hardness of 50 to 55 Rockwell C.

The heavy coating of this electrode provides a shielded arc, allowing the transfer of molten metal to take place under non-oxidizing conditions. It also provides a layer of slag which further protects the metal from the harmful effects of the air and causes the weld metal to solidify in a smooth, uniform bead.

Good deposits may be made in very thin layers if required. If shaping is necessary, the deposit may be ground to size.

Wearweld electrode is manufactured with diameters of ¼ and 3/16 in. and in 18-in. lengths. It is packed in 50-lb. steel containers.

New Calling Device for Signal Systems

A new calling device designed for use on any kind of signal system using any kind of current, has been developed by the Federal Electric Co., 8711 S. State St., Chicago, Ill. This new device, used in connection with horns, bells and sirens, is particularly recommended for code-calling use in industrial plants. Located at the switchboard and connected into the signal system, it provides 30 separate codes to call any of 30 different people. Its operation requires only setting the dial and pushing down on the plunger. Each code is repeated three times, automatically, by one setting of the dial. It is supplied in green crackle lacquer and furnished with rubber foot pads, and comes with cord and connector, ready to install.

To Signal, Set the Dial for the Desired Code, Then Push Down the Plunger.

Electric-Oxygen Torch for Cutting Steel and Cast Iron

An electric-oxygen cutting torch capable of handling heavy-duty work has been developed by I. S. Sammons, proprietor of the Pittsburg Welding Shop, Pittsburg, Kan., to whom a patent was recently issued on his invention. This torch consists of a carbon point at right angles to the torch handle. Oxygen from tanks flows through holes in the carbon, and cutting is effected by a combination of electric-arc fusion and gas flame. This torch will operate off any electric-arc welding machine, and is said to be relatively inexpensive to operate and to produce an unusually high degree of heat. It can be used for the cutting of cast iron as well as steel.

New Welding Rods to Resist Abrasion

Two welding rods for application to surfaces subject to abrasion are being manufactured and distributed for the Weld-O Alloys Co., Tulsa, Okla., by the Progressive Brass Manufacturing Co., 1702 East 6th St., Tulsa, Okla. One of these rods contains tungsten and is sold under the trade name of Weld-O (Red). It is said to be suitable for all heavy

abrasive jobs. The other hard-surfacing rod is known as Weld-O (Blue) and is claimed to give satisfactory wear on all jobs where it is not necessary to use a tungsten-contained metal. Besides combining the properties of hardness and toughness, the deposit from the rods is said to forge readily and not be affected by quenching. It is claimed that the deposits will not crack or chip off.

Trade Literature

In spot-welding production work for joining all types of forms of materials, the "Ignitron" welding timer offers many advantages for the accurate control of the time the current is on and off, which is essential in the joining of many metals, according to a leaflet recently issued by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., describing the distinctive features, construction, operation and application of the "Ignitron" timer.

Structural welding, pipe welding, repair work, building-up rail ends, sheet-metal work, welding copper, hard surfacing, and many other applications of the welding arc are illustrated and described in "FlexArc Rays," Arc Welding Data Bulletin No. 19, issued by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. In many of the applications described, particular emphasis is laid on low cost and speed of construction.

The application of hoists to both general and specific problems is discussed in Bulletin No. RH-1, issued by the Harnischfeger Corp., 4513 W. National Ave., Milwaukee, Wis. Profusely illustrated in color, with photographs of installations and diagrams, this bulletin covers the important features of P&H hoists and lists the ratings and operating ranges for Type R hoists along with specifications and electrical accessories.

The Junior Arc Welder, a low-capacity d c. welder equipped with either a 3-phase or single-phase motor and designed for bench mounting or provided with casters for portability, is described and shown in a folder issued by the Equipment Manufacturing Co., 60 Eleventh Ave. N.E., Minneapolis, Minn.

A general lathe catalog, No. 94, containing 72 pages, has been published by the South Bend Lathe Works, South Bend, Ind., and includes listings and descriptions of 96 sizes and types of lathes, and also a full line of attachments and tools for regular and special machine work.

Commercial News

New Officers Elected by Chicago Steel & Wire

Dana Summers was elected president of the Chicago Steel & Wire Co. at the annual stockholders' meeting held in Chicago on March 6th. Other officers elected were: vice-president, Loren F. Collins; secretary and treasurer, A. W. Nelson; assistant secretary and assistant treasurer, H. E. Johnston; and directors, H. R. Bliss, A. T. Carton, L. F. Collins, T. J. King, and Dana Summers.

Lukens Steel Makes Chapman Vice-President

EVERETT CHAPMAN

Everett Chapman, who joined Lukenweld, Inc., division of Lukens Steel Co., Coatesville, Pa., early in 1930 as Director of Engineering and Research, has been elected vice-president. After graduation in 1924 from the University of Michigan, with a Master's degree in physics, Mr. Chapman taught electrical engineering at Purdue University, leaving to serve The Lincoln Electric Co., of Cleveland, on experimental research and development. Since joining Lukenweld, Inc., Mr. Chapman has been credited with responsibility for that organization's engineering achievements in the application of welded steel construction to Diesel engines, presses, planers, lathes, and other machinery and equipment.

W. I. Brockson, a frequent contributor to *The Welding Engineer*, has severed his connection of ten years' duration as advertising manager of Steel Sales Corp., Chicago, and has become associated with the Commercial Advertising Agency, of Chicago. Mr. Brockson has maintained a close contact with the welding field, and has been active in advertising organizations, at present being a director of the National Industrial Advertisers Association.

Roy Thomas, of the Torch Shop, 1637 E. Vernon Ave., Los Anegeles, Calif., announces the perfection of a new type of welding torch which will be placed on the market in the near future. The torch is designed for small shop use, has but five parts, and is claimed to be absolutely back-fire-proof. Mr. Thomas' experience and ability in designing and manufacturing welding and cutting torches is well known throughout the industry.

The Harnischfeger Corp., Milwaukee, Wis., are again planning to exhibit at the World's Fair (A Century of Progress), which will open in Chicago on May 26th and continue to Nov. 1st. Present plans call for retaining their same location as at last year's Fair, on the main floor of the Travel and Transport Building.

Ralph G. Caulley has joined the Detroit district sales office of the Republic Steel Corp., according to an announcement made by N. J. Clark, vice-president in charge of sales. Mr. Caulley was connected with the Wheeling Steel Corp. for 14 years, the last seven of which were spent in the Detroit district.

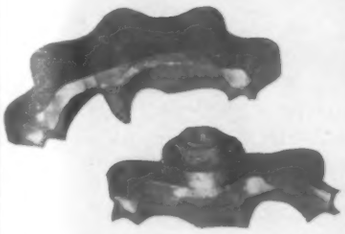
The Pratt-Brayman Co., Bedford, Ohio, announce that the Northern Auto Parts Co., Traverse City, Mich., and The Menna Welding Co., Inc., 2948 Monroe St., Toledo, Ohio, have been appointed distributors of their "Pur-Metl" cast-iron brazing compound.

Martin Wells, owner of The Wells Manufacturing Co., of 705 Amalia Ave., Los Angeles, Calif., announces that his plant is being reequipped for increased production of "Suregrip" electrode holders.

C. E. Phillips & Co., of Detroit and Chicago, have been appointed as distributors for "Nico," a welding rod manufactured by American Arc Welders, Roseau, Minn.

8 reasons *why* thousands of welders believe TOBIN BRONZE *is* better!

1 Its low melting point
2 Its free-flowing qualities
3 Pre-heating seldom required
4 Minimizes distortion
5 Makes dense, tough welds
6 Uniform in composition
7 *Made by Anaconda*
8 Sold by leading distributors



Reason No. 5 helps explain why Tobin Bronze was selected to repair-weld this head from an ammonia condenser which operates at 60 lbs. water pressure per square inch.

And Reason No. 5 helps explain why Tobin Bronze was selected to repair-weld this clam shell bucket crosshead which supports a load of 4,500 lbs.

ANACONDA
from mine to consumer

There is a suitable Anaconda Filler Rod for every bronze-welding purpose. Principal Anaconda Welding Rods, with their melting points, are listed below:

for oxy-acetylene welding

Tobin Bronze*	1625° F
Manganese Bronze	1598° F
Brazing Metal	1706° F
Electrolytic Copper	1981° F
Silicon Copper	1981° F
Phosphor Bronze	1922° F
Everdur*	1866° F

for arc welding

Silicon Copper	1981° F
Phosphor Bronze	1922° F
Everdur*	1866° F

*Reg. U. S. Pat. Off.

"TOBIN BRONZE *must* be better...my men swear by it."

This significant statement has been made by many welding foremen about Tobin Bronze... the original low melting point bronze rod. The consistently high quality which has always characterized this rod explains its popularity with thousands of satisfied users who will accept no other brand.

One of a line of seven Anaconda Copper Alloy Rods, Tobin Bronze is the most widely used... because of its widespread acceptance as the *ideal rod* for the general oxy-acetylene welding of cast iron and malleable iron. It melts at 1625° F.; preheating is usually unnecessary.

The uniform composition and unvarying quality of *all* Anaconda Welding Rods are due to the long experience and technical knowledge gained in developing a complete line for low temperature welding, both gas and electric. Available through leading distributors... usually shipped in bulk, but also obtainable in clearly labeled ten-pound packages. For information, ask for Publication B-13.

THE AMERICAN BRASS COMPANY

General Offices: Waterbury, Connecticut

Offices and Agencies: NEW YORK • CHICAGO • BOSTON • PHILADELPHIA • NEWARK • PROVIDENCE • PITTSBURGH WASHINGTON • ATLANTA • DAYTON • CINCINNATI • CLEVELAND • ST. LOUIS • HOUSTON • DENVER • SAN FRANCISCO

Manufacturing Plants: ANSONIA, CONN.; TORRINGTON, CONN.; WATERBURY, CONN.; BUFFALO, N.Y.; DETROIT, MICH.; KENOSHA, WIS.
In Canada: Anaconda American Brass Limited, New Toronto, Ontario

The special cast-iron brazing compound made by the Pratt-Brayman Co., Bedford, Ohio, is now being distributed by the Weldit Acetylene Co., 638 Bagley Ave., Detroit, Mich., under their own label.

The Johnson Welding Equipment Co., 4148 Nelson St., Chicago, Ill., is representing the Equipment Manufacturing Co., of Minneapolis, Minn., in the sale of their new Junior Arc Welder.

The Los Angeles agency of the National Welding Equipment Co., San Francisco, is being handled temporarily by the Torch Shop, 1637 E. Vernon Ave., in Los Angeles.

The Aladdin Rod & Flux Manufacturing Co., makers of welding rods for white metals, have moved their headquarters from Dayton, Ohio, to 947 Fifth St., Des Moines, Iowa.

Harbison, Inc., 1101 Mulberry St., Kansas City, Mo., have been appointed distributors by the American Steel & Wire Co. for their line of welding rods.

Notes From the Field

Welds Ash Trays for Conference Visitors

Many of the visitors at the recent Iowa State College Welding Conference carried home with them an all-welded ash tray made at the Imperial Brass Manufacturing Co. booth. These trays, while simple to make, were very attractive and the demand for them taxed the production facilities of the booth, which was in charge of A. E. Hallstrom, manager of the company's welding division, assisted by "Gus" Bluck.

The welding of these trays not only attracted the attention of those in the exhibit hall, who would gather around the booth to watch the operation, but the opportunity was given many of the visitors to handle the "Imperial" torch and weld their own trays.

Many who obtained these trays took them over to The Balbach Co. booth, where Chas. Stipp gave them a copper coating with a metal-spray gun.

The welding of these trays was also the center of attraction at the "Imperial Brass" booth at the Ohio University welding conference.

Quick Repair Job on a Warm Boiler

A frantic 'phone call one cold morning recently caused Mr. Bock, of the Bock Bros. Welding & Boiler Works, Fort Dodge, Iowa, to hurry to the place of trouble, where he found a vertical cast-iron boiler with a 6-ft. crack around the outside that had just opened up. The casting was still very hot, and Mr. Bock decided to bronze weld it before it had a chance to cool off. He sent a rush call for his welding equipment, and quickly prepared the casting for welding. With the welding finished, the casting was allowed to cool and then was tested. Two small seeps were found, and these were peened shut, after which the job was pronounced tight. The boiler was then fired up, and what looked to be a cold night ahead turned out to be quite comfortable.

Winter nights in northwestern Iowa without heat is a sad story. Naturally the customer was very grateful for the quick service, and Mr. Bock took advantage of the hot boiler to make a quick job of brazing and at the same time to save some gas, as the casting was already preheated.

Plumbing Shop Does Job Welding in Dull Times

Leichty Bros., who operate a plumbing and heating establishment in the small town of Berne, Ind., long ago recognized the possibilities and advantages of welding in connection with their regular business, with the result that the welding end of their business has been their salvation during dull times.

Back in 1926 they began using welding because they were convinced that a welded joint was superior to a screwed joint. But at the same time they realized that the amount of pipe work that could be obtained in a small town might not justify the use of the process from an economy standpoint. However, they felt that they owed it to their customers to give them the best in workmanship and materials. Naturally, they turned to job welding as a means of making their welding equipment pay for itself. Today they are doing both oxyacetylene and arc welding, and are using the process for furnaces, to repair leaks in pipe lines, and to make up special fittings, in addition to the regular line of job welding work such as a rural community would have. Occasionally they obtain a job of considerable size, such as making alterations in the Hoosier Condensed Milk Plant at Bluffton, Ind., where all the piping was welded.

His Customers Don't Mind If He Attends Conference

Job-shop owners who think they can't leave their business long enough to take in the welding conferences might consider how this problem was solved by Ed. H. Birdsell, job-welding-shop owner of Madrid, Iowa. Every year at the time the welding conference is held at Iowa State College at Ames, Iowa, Mr. Birdsell closes his shop and attends all the conference sessions.

For several days previous to the conference, he advertises that he shall be away to a welding school for three days so his customers will know why he is not in the shop on those days and will know that he is keeping up with developments in welding application and procedure and may bring back with him some ideas that will be of benefit to them. He finds as a result that his customers have more faith in him and his work.

A large welding job, 12,000 miles from home, is under way by the Standard Oil Co. of California, as its oil tanker *El Segundo* sailed recently for Bahrein Island, off the coast of Arabia. The vessel carries a large crew of welders, engineers, and workmen who will construct a large welded submarine pipeline and loading terminal for loading oil from a large producing field of the company. The completion of this project will require about nine months.

The Elco Welding Works, of Berkeley, Calif., recently purchased a new 300-ampere Schrader welding unit, and in addition to this has installed special equipment for welding and recoring radiators. E. L. White, owner of the shop, reports that he has been quite busy for some time in his specialty work of installing seismic braces in buildings for withstanding lateral stresses caused by earthquakes.

A contract to build a quantity of boxes to be used in the factory of the Ziegler Candy Co., Milwaukee, in the making of hard candies, has been awarded to the Bruce Welding Shop, Milwaukee, Wis. These boxes, to be constructed of 16-gage sheet, will be 22x18 in. at the top, 11 in. deep, and with 16x18-in. bottoms. They will be entirely oxyacetylene welded and will be given a galvanizing treatment.

A strictly cash basis of doing business with no credit extended, has worked out well for his shop, says E. H. Hartman, operator of a blacksmith and welding shop in Glidden, Iowa. Mr. Hartman's shop is in a small community where everyone knows everybody else and where many think it would be suicidal to do business without extending credit.

A large amount of welding was recently completed at Huntington Beach, Calif., in the construction of a new natural-gas absorption plant for the C. C. Field Gasoline Corp. The plant is one of the largest of its kind in the Southern California oil fields, and has a capacity of 40,000,000 cu. ft. of gas per day.

Welding broken tines in coal forks has meant some good business for Lewis Lipp, of Wayne, Ohio. He uses Oxweld No. 3 steel rod and tempers the finished weld in oil. Many of the forks repaired by him have been returned for other tines to be welded, but none of the welded tines have broken so far.

Del's Welding Service is the name of a new welding shop recently opened for business at 1724 American Avenue, in Long Beach, Calif. Mr. Halberg, proprietor, features general job-shop welding, specializing in automotive and starter teeth work. He has had 20 years' experience in the welding field.

Since the recent death of Fred Spaeth, pioneer manufacturer and an expert in refrigerating machine and blacksmith work, his business, operated under the name of the Spaeth Manufacturing & Machine Shop, 3100 Floyd St., Dallas, Texas, has been taken over by W. P. Spaeth and Fred Spaeth, Jr.

The East Texas oil field is furnishing work for a large crew of welders in the construction of four more oil refineries on the Kilgore-Longview Highway, near Kilgore. Two of the plants are being constructed for the Utah Refining Co. and two are for the Roco Refining Co.

H. H. Freysinger, of New Bloomfield, Pa., who specializes in welding and brazing, is enlarging his shop. So far this winter he has repaired 21 automobile castings broken by freezing, using the electric arc, and every one of these customers is satisfied, he says.

One of the CWA projects in California is the laying and welding of several miles of water pipeline for the water department of the city of Redlands. The pipe is of 20- and 22 -in. diameter. Completion of the line is scheduled for May 1st.

E. F. Ayalia, of 3451 Whittier Boulevard, Los Angeles, Calif., recently opened a general job welding shop, specializing in general automotive welding and cast-iron repair. The shop will operate under the name of the Angeles Welding Works.

R. S. Davis, job-welding-shop proprietor of Des Moines, Iowa, is building a new welding shop at 523 Fourteenth St., which is a few doors from his present address. The new building will be 35 ft. wide by 48 ft. long and of concrete-block construction.

The Western Welding Works, of Los Angeles, Calif., reports the recent installation of an 1,800-gallon welded fuel-oil tank for the Los Angeles Crematory, at Venice and Catalina Boulevards, in Los Angeles.

The Pfeiffer Boiler & Repair Works, 5910 N. Western Ave., Chicago, Ill., recently installed a small "Sight Feed" unit for generating acetylene gas.

Gust Buenning, proprietor of the Good Welding Co., Milwaukee, Wis., has moved his shop from 1042 N. Market St. to 935 (rear) N. Market St.

The Indiana & Michigan Power & Light Co. have purchased a "Metallizing" unit for their Twin Branch Plant at Mishawaka, Ind.

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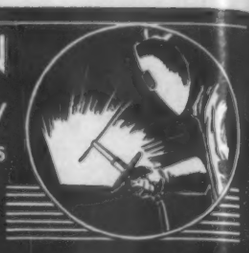

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